

OPHTHALMIA NEONATORUM

BY

SYDNEY STEPHENSON

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OPHTHALMIA NEONATORUM

WITH ESPECIAL REFERENCE TO ITS
CAUSATION AND PREVENTION.

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OPHTHALMIA NEONATORUM, WITH ESPECIAL REFERENCE TO ITS CAUSATION AND PREVENTION.

INTRODUCTION.

Ophthalmia neonatorum may be defined as an inflammatory disease of the conjunctiva, usually appearing within the first few days of life, and generally due to the action of micro-organisms.

The disease has been recognised since the dawn of medicine, as might be expected in an affection of which the clinical features are so characteristic. Soranus and Aetius expressly refer to the malady. The ancients, moreover, adopted certain crude methods of prevention, such as the application of oil to the eyes of newly-born babies. Those interested in the historical aspect of ophthalmia neonatorum will, however, find full details, together with quotations from the earlier writers, in the works of Haussmann (*Die Bindegauinfektion der Neugeborenen*, 1882) and especially of Hirschberg (*Centralbl. f. prakt. Augenheilkunde*, 1894).

Our first point of enquiry is with regard to the prevalence of ophthalmia neonatorum. The material at disposal is derived from four sources: first, lying-in hospitals; secondly, London and provincial poor-law maternities; third, foundling hospitals; and, lastly, eye hospitals and cliniques. The material, although abundant enough as far as it goes, is lacking in certain important particulars. This will be apparent when it is stated that few figures are extant with regard to the prevalence of ophthalmia among the offspring of the upper and of the lower classes of mothers, confined in their own homes. But it has been surmised that ophthalmia occurs less frequently among the upper classes than in the lying-in hospitals, and more frequently among the lower classes. The truth of the former statement is attested by the experience of every ophthalmic surgeon, who counts ophthalmia neonatorum amongst the rarer diseases in his private work. It was substantiated by Credé (*Arch. für Gynäk.*, Band XVII, 1881, p. 50), who in 1881 spoke of ophthalmia as rare in the higher classes, common among the proletariat, and as a continual source of trouble in the lying-in hospitals.

The second statement is in accordance with the experiences of medical men who attend the poorest class of women at their own houses. Another factor that probably made for a higher proportion of ophthalmia among the last-named class, at least until recently, is the fact that in England, at all events, a majority of the confinements are conducted by midwives. W. G. Sym (*Edinburgh Medical Journal*, May, 1896) explains the fact that ophthalmia is commoner in England than in Scotland on the assumption that rather more than one-half the births are attended by midwives in the former country, whereas in the latter a majority of the child-beds are looked after by qualified medical practitioners.

One important fallacy underlying the statistics to be quoted presently refers to the varying standard adopted at the various institutions as to what constitutes "ophthalmia." For example, under that term some will include every kind of conjunctival inflammation occurring in a newly-born baby, while others will take cognisance of severe cases alone. A striking discrepancy, only to be explained in this way, is mentioned by Ernst Fuchs in his famous *Die Ursachen und Verhütung der Blindheit*, 1885. At two Berlin institutions for the delivery of women, drawing their inmates from the same social class, the percentage of ophthalmia among children born alive, over a term of many years, ranged in the one case from 1·07 to 8·3 and in the other from 7·4 to 21·3.

A similar fallacy doubtless underlies the figures obtained from one and the same institution. The resident medical officers at those places undergo continual change, and this in all likelihood has no small share in shaping the figures. It is difficult on any other ground to explain the extraordinary variation in the percentage-incidence of ophthalmia observed from year to year at the same institution. One or two examples may render this point clear.—Haussmann collected figures with regard to the prevalence of ophthalmia from a number of German lying-in hospitals, and large variations were to be met with in some of the tables he gave. For instance, at the Stuttgart Lying-in Institution from 1828 to 1879 ophthalmia attacked from 5·8 per cent. to 20·59 per cent. of the babies born alive. At Dresden (1826-1875) the ophthalmia cases varied from a minium of 2·2 per cent. to a

maximum of 25·3 per cent. At the Munich Lying-in Institution, over a period of twenty-two years, the incidence of ophthalmia varied from as little as 0·8 per cent. to as much as 5·2 per cent. (*Arch. f. Gynäk.*, 1883, p. 386).

There are other points to be borne in mind when attempting to estimate the value to be placed upon the figures obtained from maternity institutions, namely, the influence upon ophthalmia of the antiseptic system introduced by Lord Lister in 1867, of the discovery of the gonococcus by Neisser in 1879, and, last but not least, of a rational method of prophylaxis by Credé in the year 1881.

A Table showing the incidence of Ophthalmia Neonatorum in fifteen Continental maternity institutions. The returns have been abridged from Haussmann's "Die Bindehautinfection der Neugeborenen" (1882).

Institution.	Number of Years.	Live Births.	Ophthalmia Neonatorum	Ophthalmia, Percentage of.
Berlin University	29	21,746	716	3·29
Berlin Charité	16	6,150	770	12·52
Breslau Midwives' Lying - in Institution	2	333	28	8·40
Breslau Gynaecological Klinik ...	2	593	28	4·72
Dresden Lying-in Institution ...	43	18,242	1,880	10·30
Halle	23	2,399	280	11·67
Königsberg	1	130	12	9·23
Leipzig	2	712	81	11·37
Marburg	10	1,087	85	7·8
Munich	1	563	11	1·9
Stuttgart	3	1,136	138	12·14
Würzburg	40	6,231	21(?)	0·3
Vienna Medical Lying-in Klinik...	8	34,579	476	1·37
Vienna Nurses' Lying-in Klinik ...	4	14,838	153	1·03
Petersburg Institution for Nurses	8	9,750	123	1·26
Totals	118,489	4,802	4·05	

A glance at the table will show that the figures derived from the German, Austrian, and Russian lying-in institutions range from as little as 0·3 per cent. of ophthalmia, on the one hand, to as much as 12·52 per cent., on the other. As the numbers dealt with are in most instances large, any purely statistical fallacy may be excluded. One point stands out clearly, *viz.*, that two-thirds of the returns show that the incidence of ophthalmia amounted to upwards of 3 per cent. of the living babies born in the various institutions. Among the total number (118,489) of babies, ophthalmia occurred in 4·05 per cent. The great variations as between the several institutions must be explained by (*a*) the lack of a fixed standard, and (*b*) the care exercised in collecting the figures. Lastly, it must not be forgotten that the statistics quoted mostly date from a period long anterior to the general introduction of efficient prophylaxis in maternity hospitals.

Figures dealing with the incidence of ophthalmia in British Lying-in Institutions are by no means easy to come at. Those given below, however, deal with the recent experiences of some of the more important hospitals, and are all that I have been able to obtain :

A Table showing the incidence of Ophthalmia Neonatorum in six British Lying-in Hospitals.

Institution.	Observer.	Period.	Births.	Ophthalmia Neonatorum	Ophthalmia percentage of.
Queen Charlotte's Hospital, London.	—	1896-06	13,644	42	0·307
Rotunda Hospital, Dublin.	Dr. E. Hastings Tweedy.	1903-06	5,158	8	0·15
City of London Hospital.	Dr. Clement Godson	1901-06	3,532	4	0·113
British Lying-In Hospital, London.	Dr. G. Drummond Robinson.	1898-06	7,090	3*	0·04
Maternity Hospital, Glasgow.	Dr. R. Jardine.	1906	574	4	0·69
Maternity Hospital, Clapham, London.	Dr. Annie McCall.	1889-06	5,817	18	0·309
Totals			35,815	79	0·22

*Dr. G. Drummond Robinson, Physician to the British Lying-In Hospital, whom I have to thank for the foregoing figures, informs me that in addition to the three cases mentioned above, three others occurred, all on the eighth day after delivery.

The incidence of ophthalmia in the above institutions, as will be seen from the table, is creditably low, namely, 0·22 per cent. among 35,815 babies born alive. It is due partly to the antiseptic and aseptic conditions by which modern science has surrounded the childbed, and still more in this case to the universal adoption of some efficient method of prophylaxis, as will be explained later.

In the following table a comparison is instituted between the incidence of the disease in the Continental and the British maternities. It should be borne in mind, however, that the figures refer to very different periods :

Institution.	Births.	Ophthalmia.	Ophthalmia, percentage of.
15 Continental Maternities, before the year 1882.	118,489	4,802	4·05
6 British Maternities, after the year 1882.	35,815	79	0·22

In the year 1896, at the instance of the Local Government Board, the present writer obtained some figures with regard to the prevalence of ophthalmia neonatorum in the lying-in wards of the London Poor-Law Infirmarys and Workhouses. To some extent these Poor-Law departments are comparable with the lying-in charities, although it is probable that, on the whole, they draw their inmates from a lower social class. Still, they are under direct medical supervision, and the labours are conducted by qualified women. Briefly stated, the figures obtained came out as follows :—during a period of two years (1894-5) 4,884 living babies were born, and of that number 176 developed ophthalmia. In other words, of the children who entered the world under the auspices of the Poor-Law during the period reviewed, no less than 3·60 per cent. became diseased. The variations between the different institutions shown in the table were largely accounted for by the difficulties of a fixed standard, and by the different measures of prophylaxis adopted at the various places.

*Ophthalmia Neonatorum.**Ophthalmia Neonatorum in London Lying-in Wards (1894-95).*

Institution.				Period.	No. of Births (excluding still- births, and those born outside).	Purulent Ophthalmia.	Percentage.
Lewisham	...	...	...	2 years.	107	1	0.93
Fulham	...	...	...	„	357	9	2.52
St. Giles	...	...	...	„	67	—	—
Whitechapel	...	...	...	„	143	7	4.89
Poplar	...	...	...	„	138	7	5.72
Strand	...	...	...	„	96	—	—
Islington (1)	...	...	...	„	(1) —	(1) —	(1) —
Mile End	...	...	...	„	116	3	2.58
St. Olave's	...	...	...	„	129	9	6.97
Hampstead	...	...	...	„	40	1	2.50
Hackney	...	...	...	„	206	14	6.79
St. George-in-the-East	...	...	...	„	126	3	2.38
Holborn	...	...	...	„	199	6	3.01
Bethnal Green	...	...	...	„	134	1	0.74
Stepney	...	...	...	„	44	1	2.27
Shoreditch	...	...	...	„	179	7	3.91
Greenwich	...	...	...	„	142	22	15.49
Lambeth	...	...	...	„	508	1	0.19
Westminster	...	...	...	„	86	1	1.16
City of London	...	...	...	„	23	5	21.73
Wandsworth and Clapham	...	...	...	„	290	12	4.13
Kensington	...	...	...	„	240	3	1.25
Camberwell	...	...	...	22 months.	175	10	5.71
St. George's	...	...	...	2 years.	131	19	14.50
St. Saviour's	...	...	...	„	97	—	—

(1) Islington.—The number of births during the last two years has been 255, but prior to July, 1896, no official record was kept of cases of purulent ophthalmia.

Institution.	Period.	No. of Births (excluding still-births, and those born outside).	Purulent Ophthalmia.	Percentage.
St. Marylebone	2 years.	283	7	2.47
Paddington	„	210	(2) —	—
St. Pancras	„	371	(3) 8	2.15
Woolwich	„	63	(4) 2	3.17
Chelsea	„	184	17	9.23
Totals	—	4,884	176	3.603

As compared with the figures from Continental lying-in hospitals (page 3), the returns from the Metropolitan lying-in wards are favourable, but it must be borne in mind that the former were obtained prior to the year 1881, which marked a new era in the preventive treatment of ophthalmia neonatorum. They are certainly higher than they should be in carefully conducted departments, and contrast unfavourably with the returns from British Maternity Hospitals, given above.

As regards ophthalmia neonatorum in provincial poor-law lying-in wards, the following comprehensive table has been constructed from figures supplied to the writer by the kindness of Dr. Andrew Fuller, Local Government Board Inspector. The table includes almost all of the English and Welsh towns and cities the population of which exceeds 100,000.

A Table showing, for fifty-three Provincial Poor-Law Lying-In Departments, the number of living children born over a term of years, and the number of cases of severe (purulent) ophthalmia, together with the percentage of the cases of ophthalmia.

(2) Paddington.—Two instances of "blight," both well under a week, not counted as purulent ophthalmia.

(3) St. Pancras.—Thirty-two children entered as having "ophthalmia," but probably not more than seven or eight of these were examples of purulent ophthalmia.

(4) Woolwich.—The medical superintendent, Dr. Boulter, mentions one case of purulent ophthalmia, and three of some milder form of inflammation. The above figure, therefore, is only approximately correct.

Ophthalmia Neonatorum.

Town.	Population.	Observer.	Period.	Number of infants born alive.	Number of cases of severe (purulent) ophthalmia.	Percentage of ophthalmia.
Liverpool.	684,947					
1. Brownlow Hill ...	—	W. Alexander...	1893—1906	1,334	7	0·52
2. Toxteth Park ...	—	D. Smart	1897—1906	479	3	0·62
Manchester.	543,969					
1. Chorlton Union (*)	—	J. S. Orchard...	1897—1906	*	*	*
2. Crumpsall ...	—	A. H. Burgess...	1897—1906	†	†	†
3. Barton-upon-Irwell	—	W. Race ...	1897—1906	149	1	0·67
Birmingham.	522,182					
1. King's Norton ...	—	J. Hora ...	1898—1906	428	—	—
2. Aston ...	—	E. H. Birchell	1897—1906	660	2	0·303
3. City of Brmnghm.	—	E. R. Cooper...	1897—1906	1,527	1	0·065
Leeds...	428,953	J. Allen ...	1897—1906	738	7	0·94
Sheffield ...	380,717					
1. Ecclesall, Bierlow	—	A. K. Gale ..	1900—1906	321	—	—
Bristol.	328,842					
1. Stapleton W'house	—	R. H. Norgate	1897—1906	297	2	0·67
2. Eastville W'house	—	F. C. Morgan...	1897—1906	549	—	—
Bradford.	279,809					
1. City ..	—	B. H. Slater ...	1893—1906	213	1	0·469
2. North Bierley ...	—	W. Cunliffe ...	1897—1906	106	1	0·94
Newcastle-on-Tyne ...	264,511	S. S. Whillis ...	1897—1906	366	2	0·54
Nottingham.						
1. Bagthorpe ...	239,753	H. G. Ashwell	1897—1906	588	5	0·85
2. Basford ...	—	H. J. Neilson...	1897—1906	183	2	1·09
Hull.	192,497					
1. City of Hull ...	—	S. R. Henson...	1898—1905	222	1	0·45
2. Sculcoates ...	—	H. Robinson ...	1897—1906	335	—	—
Portsmouth ...	189,160	H. W. Morley	1898—1906	453	9	1·98
Bolton ...	168,245	Lewis Buck ...	1897—1906	416	3	0·72
Oldham ...	137,238	Ralph Young ...	1899—1906	352	5—6	1·42
Blackburn ...	127,527	W. R. Pollard...	1898—1906	255	1	0·39
Brighton ...	123,478	D. M. Ross ...	1897—1906	613	8	1·305
Preston ...	112,982	T. Pimley ...	1897—1906	327	1	.0305

(*) The returns from the Chorlton Union must be taken separately, since they make no distinction between mild and severe cases of ophthalmia, as is done in the other figures included in the table. During the ten years, 1897 to 1906, there were 1,140 living children born, and the aggregate number of cases of ophthalmia, mild and severe, for the same period was 27, or 2·36 per cent. It may be noted that 26 of the cases occurred in the period 1897—1901, and 1 only since, 1902—1906.

(†) No distinction made between mild and severe cases. During the ten years (1897—1906) there were 1,063 births and 13 cases of ophthalmia, or, 1·27 per cent.

Towu.	Population.	Observer.	Period.	Number of infants born alive	Number of cases of severe (purulent) ophthalmia.	Percentage of ophthalmia.
Norwich	111,728	C. J. Muriel	1897-1906	*	*	*
Birkenhead	110,926	G. S. Stansfield	1897-1906	442	2	0.45
Plymouth	107,509	Charles J. Cooke	1897-1906	328	10	3.04
Derby	105,785	C. W. Iliffe	1897-1906	204	—	—
Halifax	104,933	J. F. Woodyatt	1901-1906	151	3	1.98
Southampton	104,911	R. Bencraft	1902-1906	101	1	0.99
South Shields	97,267	S. Spence	1897-1906	331	2	0.604
Huddersfield	95,008	David Wilson	1897-1906	132	2	1.51
Swansea	94,514	E. B. H. Hughes	1897-1906	240	2	0.83
Wolverhampton	94,179	T. H. Galbraith	1899-1906	346	2	0.057
Middlesborough	91,317	W. Brander	1900-1906	180	2	1.10
Walsall	86,440	G. M. Fox	1897-1906	251	2	0.79
Stockport	78,871	W. B. Bale	1898-1906	355	5	1.408
Merthyr Tydfil	69,227	L. W. Ward	1897-1906	254	1	0.39
Wigan	60,770	J. A. Bradbury	1897-1906	243	1	0.41
Hunslet	59,321	Joseph Buck	1897-1906	128	1	0.78
Bury	58,028	Thomas Mellor	1897-1906	154	2	1.29
Tynemouth	51,514	E. Bramwell	1897-1906	229	1-2	0.43
Dudley	48,809	T. F. Higgs	1897-1906	230	6	2.60
Edmonton, Middlesex	46,899	W. B. Benjafield	1897-1907	547	2	0.36
Ashton-under-Lyne	43,890	W. H. Hughes	1897-1906	239	1	0.41
Barnsley	41,083	E. B. Collins	1897-1906	131	—	—
Chester	36,281	C. Jephcott	1897-1906	†	†	†
Kingston-on-Thames	34,375	J. Donald	1897-1906	418	7	1.67
Pontypridd	32,319	H. Davies	1897-1906	285	—	—
Stoke-on-Trent	30,456	J. M. Longford	1897-1906	429	8-9	1.86
Dewsbury	28,050	S. L. Potter	1899-1906	131	1	0.76

(*) No records available. (†) No distinction made between mild and severe cases of ophthalmia.

Ophthalmia Neonatorum.

Town.	Population.	Observer.	Period.	Number of infants born alive.	Number of cases of severe (purulent) ophthalmia	Percentage of ophthalmia.
Brentford, Middlesex	15,171	E. E. Norton	1904—1906	189	2	1·05
Totals	...	...	...	17,579	128	0·72

The figures given above, drawn from the most various parts of England and Wales, show that as regards the preventive treatment of ophthalmia most of the provincial poor-law institutions occupy much the same high plane as the principal maternity hospitals in London and elsewhere. They speak volumes for the care exercised in those places, sometimes doubtless under considerable difficulties. In some of those departments, indeed, such as those belonging to King's Norton (Birmingham), Eastville (Bristol), Derby, Sculcoates (Hull), Barnsley, Pontypridd, and Ecclesall, not a single case of ophthalmia neonatorum has been met with over a term of several years, a tribute to the efficacy of the prophylactic measures adopted! As regards the other returns all, with the exception of thirteen, fall below 1 per cent., which I regard as a sort of standard that, when exceeded, appears to call for some sort of explanation. Of the entire body of returns, which number no fewer than fifty-three, two only—namely, Plymouth and Dudley—show an ophthalmic morbidity exceeding 2 per cent. With regard to Plymouth, venereal disease is known to be common in that centre of naval and military activity, and pregnant women affected with those diseases are drafted from the lock wards to the poor-law lying-in department for confinement. Briefly, these poor-law statistics show in a striking way the diminution that has occurred in ophthalmia neonatorum within recent times, as a comparison with the figures derived from the Metropolitan lying-in wards in 1894-95 will prove. In the latter the average incidence of the disease was 3·603 per cent. of the births; in the former only 0·72 per cent. From this point of view it is difficult to overestimate the importance of the figures.

The figures to be next adduced are from foreign foundling hospitals, and here again variations are to be noted, although to

nothing like the same extent as in the case of the lying-in hospitals.

A Table to show the percentage of ophthalmia among the babies admitted to four foreign foundling hospitals. (From Haussmann's "Die Bindehautinfection der Neugeborenen," 1882.)

Institution,	Years.	Children admitted.	Ophthalmia.	Ophthalmia, Percentage of.
Vienna	12	130,104	5,616	4.31
Petersburg	10	40,816	2,813	6.89
Prague...	3	10,188	1,106	10.8
Gratz ...	—	3,433	238	6.9
Totals ...		184,441	9,773	5.29

Next, we may review the figures obtained from ophthalmic hospitals and departments, showing the proportion borne by ophthalmia neonatorum to the other diseases of the eye met with in those places. It will be obvious that the statistics, although of some interest, can yield no correct notion as to the prevalence of ophthalmia in the outside world, since the poorer and more severe cases only, as a rule, are presented for hospital treatment. The full figures will be found in the appendix. Here the British, American, and Continental figures will merely be quoted *en masse*:

A Table to show the proportion of cases of Ophthalmia Neonatorum presented for treatment at Eye Hospitals in various parts of the world.

Country.	Number of Eye Cases.	Number of Cases of Ophthalmia Neonatorum.	Percentage of Cases of Ophthalmia Neonatorum.
1. British ...	407,202	5,129	1.25
2. American ...	941,080	4,447	0.47
3. Other Countries ...	3,007,692	7,251	0.24

The incidence of ophthalmia neonatorum nowhere reaches 1 per cent. except in the British Isles (1.25 per cent.), Mexico (1.53 per cent.), Spain (1.176 per cent.), Portugal (1.146 per

cent.), France (1.10 per cent.), and in some parts of the United States—as, for example, New Orleans (1.17 per cent.). The high percentage noted in Great Britain is due to the inclusion of the returns from the Manchester Eye Hospital for the decade 1876-1886, during which period, of the 112,431 patients admitted, 3,417 were cases of ophthalmia neonatorum. If the Manchester figures are omitted from the calculation, we find that among 294,781 cases, there were 1,612 instances of ophthalmia neonatorum, or 0.54 per cent.

The last figures to be quoted, although somewhat contradictory, and not so large as one might desire, are, in the writer's opinion, the most valuable, inasmuch as they refer to the proportion borne by the disease to all registered births in certain towns or countries where a statistical enquiry has been made, or where the notification of the malady is compulsory. According to Cohn (*Centralbl. f. prakt. Augenheilkunde*, April and May, 1895), in the city of Breslau during the year 1894, 12,000 births were registered, and of that number at least 250 infants, or 2.35 per cent. were affected by ophthalmia. Widmark (*Ibidem*, September, 1895) showed nearly the same proportion (2.27 per cent.) among the babies born in Stockholm during the year 1884. The same author (*Rev. générale d'ophthalmologie*, April 30, 1888) estimated that 0.32 per cent. of all infants born in Sweden during the year 1885 were affected with ophthalmia. In Mecklenburg-Schwerin, according to Schatz (*Deutsche med. Wochenschrift*, 1884, No. 1), among 18,000 babies in 1882, 90, or 0.5 per cent., were affected with ophthalmia. As regards Switzerland, A. Heim (*Inaugural-Dissertation, Universität Bern*, 1895) tells us that in the year 1892 ophthalmia attacked 0.45 per cent. of 83,596 babies born alive. Valuable figures have recently been furnished by Alvarado (*Oftalmia purulenta de los recién nacidos*, 1904), according to whom there were in 1897, 2,292 births, and 67 cases of ophthalmia in Valladolid, Spain—that is, 2.933 per cent. Alvarado calculated that in 1892 the proportion for the whole of Spain was 1.236 per cent. Rosel (quoted by Alvarado) estimated that at Vals, a Catalan town of 13,000 inhabitants, there were from 1890 to 1896, 2,226 births and 30 cases of ophthalmia, or 1.34 per cent.

It is no exaggeration to say that in former times the amount of mischief yearly done by ophthalmia neonatorum was simply appalling. That disease was the cause of more blindness than any other local affection of the eyes, atrophy of the optic nerve alone excepted. Magnus (*Die Verhütung der Blennorrhœa neonatorum und der sich daraus entwickelnden Blindheit*, 1884) found that ophthalmia neonatorum accounted for upwards of 10 per cent. of his 2,528 cases of blindness, a result substantially confirmed by Rousseau in France, by Schaefer in Russia, and by Oppenheimer in America. S. M. Burnett (*The Century*, 1892) has calculated that of the 50,568 blind persons in the United States, as disclosed by the census of 1890, no fewer than 39 per cent. owed their unhappy state to ophthalmia in infancy. Lucien Howe (*American Journal of Ophthalmology*, August, 1897) estimated that at least 5,000 people in the United States had been blinded by ophthalmia neonatorum. Haussmann, in his remarkable monograph, showed by means of elaborate figures, that of those seeking admission to the asylums of Germany, Austria, Denmark, and Holland, 8·27 per cent. to 60·52 per cent. had been blinded by this disease. Emrys-Jones (*On Ophthalmia Neonatorum*, Manchester, 1881), among 72 candidates presented for entry to Henshaw's Blind Asylum, traced the blindness to ophthalmia in 75 per cent. The Ophthalmological Society of the United Kingdom has reported (*Transactions*, Vol. IV, 1884, p. 33) that from 30 per cent. to 41 per cent. of the inmates of four British blind asylums were there on account of this disease. Simeon Snell (*Lancet*, September 1, 1888) found that of 93 inmates of the Sheffield School for the Blind, no fewer than 37, or 39·7 per cent. owed their blindness to ophthalmia neonatorum. On the other hand, the proportion among adults employed at the Sheffield workshops was 26·3 per cent.

According to Cohn, in the year 1876, there were, in 22 German Blind Asylums, about 30 per cent. blinded from ophthalmia neonatorum, whereas in the year 1896—that is, twenty years later—the proportion had sunk to 10 per cent.

The Royal Commission on the Blind, the Deaf, and the Dumb (which reported in the year 1889) estimated that about 7,000 persons in the United Kingdom had lost their sight from

this disease. This number of disabled people may be taken to represent an annual burden upon the commonwealth of £350,000, or upwards of one-third of a million sterling. Every blind adult probably constitutes a yearly charge of £25 upon the charitable, while the State, on a low estimate, loses an equal amount. From a purely commercial point of view, therefore, it would be worth while to reduce as low as possible the ravages of a disease which can be shown to be both preventable and curable.*

Before leaving the subject, certain figures collected from eye hospitals and cliniques may be quoted, since they show the percentage of damaged eyes resulting from ophthalmia in these particular institutions :

A Table showing the proportion of Eyes damaged as the result of Ophthalmia Neonatorum in Ophthalmic Hospitals.

Name.	Reference.	Period.	Ophthalmia neonatorum.	Percentage of lost or damaged eyes.
Horner ...	<i>Corresp.-Blatt f. schweizer Aerzte</i> , 1882, No. 7	1859-1881	468	33·0
Heymann ...	<i>Prager Vierteljahrs.</i> , 1860, 11, p. 70	—	139	18·0
Hirschberg	<i>Beiträge z. prak. Augenheilk.</i> , 1876, p. 6	—	200	27·5
Schöler ...	<i>Jahresbericht</i> , 1880, p. 7	—	156	27·5
Schatz ...	<i>Deuts. med. Wochens.</i> , 1884	—	172	20·0
Galezowski	<i>Gaz. des Hôpitaux</i> , April, 1882, p. 331	—	507	21·50
Manchester Eye Hospital	<i>British Medical Journal</i> , April 7, 1883, p. 690	1882	539	13·7
Emrys-Jones	<i>British Medical Journ.</i> , March 5, 1881, p. 344	—	420	17·1
Mules ...	<i>Medical Chronicle</i> , Jan., 1888	1876-1886	1,405	61·58
Prince and Woodruff	<i>Medical Record</i> , August 26, 1893	1892-1893	53	22·64
Widmark ...	<i>Centralbl. f. prak. Augenheilkunde</i> , p. 262, 1895	1884-1885 1887-1888	—	17·5
McKenzie and Marshall. C.D.	<i>Royal Lond. Ophthalmic Hospital Reports</i> , December, 1896.	1896	100	17·43
Tyrrell, F.A.C.	<i>Practitioner</i> , April, 1902	1900-1901	168	33·3
Alvarado ...	<i>Ophthalmie des Nouveaux-Nés</i> , Valladolid, 1903	—	962	14·65
Santos Fernandez	<i>Ibidem</i>	1875-1896	499	19·23
Totals :—			5,995	22·85

*It was shown by the United States census for the blind and deaf (1900), that of the totally or partially blind, 7,369 had become so before the completion of the first year of life. Of this number Ophthalmia Neonatorum was probably the cause of the blindness in 25.02 per cent.—(*Journ. Amer. Med. Assoc.*, June 15, 1907).

In reference to these figures, it is merely necessary to point out that the more severe cases of ophthalmia only, as a rule, seek hospital relief. The proportion of eyes damaged by the disease, therefore, stands higher than it would if tables could be constructed which included all cases, mild and severe.

On the other hand, figures collected from maternity hospitals (such as those quoted below) place the proportion of eyes damaged by ophthalmia too low. For this there are two main reasons: first, because the infants are treated medically at the earliest possible moment; and, secondly, because damage to sight may ensue after the mother and baby leave the institution, say, from the twelfth to the fifteenth day after confinement.

A Table showing the damage to the cornea sustained by babies who suffer from ophthalmia in maternity hospitals. (Figures taken from Fuchs's "Die Ursachen und Verhütung der Blindheit," 1885.)

Hospital.	Cases of Ophthalmia.	Percentage of lost or damaged eyes.
Berlin Charité	213	1·9
Munich Maternity	123	2·4
Dresden Maternity	1,378	3·8
Stuttgart Maternity	538	4·6

The conditions in foundling hospitals are very different, inasmuch as most of the babies are in a neglected and diseased state upon admission. The proportion of injured eyes is therefore high as regards those particular institutions. For example, at the Vienna Foundling Hospital it was recorded in 21 per cent. of 1,347 diseased babies, and at the Prague institution in 45·7 per cent. of 300 babies with ophthalmia.

A better general idea of the damage done by ophthalmia is to be gained from a study of the collective investigations made by Schatz, Heim, Cohn, and Alvarado respectively. Among the 90 cases collected by Schatz (*Deutsche med. Wochenschrift*, 1884, No. 1) in the German state of Mecklenburg-Schwerin in the year 1882, 71 recovered without damage to sight. With

regard to the 19 remaining babies, 3 were completely blinded, 6 were blinded in one eye, while 10 sustained more or less damage to sight. Heim (*Inaugural Dissertation, Universität Bern*, 1895) estimated that in Switzerland at least 5 per thousand of the total number of babies born annually suffered from ophthalmia—that is to say, some 400 cases in all. Of that number, 60 to 70 sustained lasting damage to sight, and 16 of them became wholly or partially blind. In this way ophthalmia neonatorum, according to Heim's calculations, blinded 15 babies every year in Switzerland. Cohn (*Ueber Verbreitung und Verhütung der Augenerkrankungen der Neugeborenen*, 1896, p. 28) collected from 45 colleagues statistics dealing with 898 cases of ophthalmia neonatorum, and found that 105 presented blemishes of one or of both corneæ, while 36 were blinded in one or both eyes.

Of the 41 cases of ophthalmia neonatorum examined by the writer during his inspection of the London Poor-Law children (*Report upon the Ophthalmic State of Poor-Law Children in the Metropolis*, 1897) he found 4 blind in both eyes and 6 in one eye each. Among the other eyes damaged, but not blinded by the disease, 7 were estimated to retain 1/10 normal sight, 1 to have 1/3, 1, 1/2, while 3 other eyes were blemished, although not in such a way as to be likely to impair vision. Of the 41 infants with ophthalmia, therefore, 39·02% had sustained permanent and serious damage to sight.

From the figures just quoted, it might, perhaps, be concluded that ophthalmia neonatorum, as it occurs in parochial lying-in wards, damaged the cornea in more than one-third of the cases. Such a conclusion, however, would be erroneous for the following reason:—severe ophthalmia, complicated with corneal mischief, would naturally be detained for weeks or months in the infirmary or workhouse, while babies who soon recovered would be allowed to leave with their mothers at the expiration of the usual period. This fact probably accounts for the disproportionate number of damaged eyes found during the investigation.

Indeed there was evidence to show that the disease in the London lying-in wards damaged sight much less frequently. For example, among 157 of the cases mentioned in the table on page 6, only 20, or 12·73 per cent., are returned as

having sustained any damage to the eyes. This figure, it is true, must be accepted with some reserve, because exact records were not always kept with regard to the termination of the cases. Besides, mischief may have ensued after leaving the institution, especially when mothers insisted, as they sometimes did, on taking their discharge with their infants contrary to medical advice.

There is another way whereby one may form some idea as to the mischief entailed by ophthalmia neonatorum—namely, by analysing the total number of damaged eyes met with during the present writer's investigation of 17,002 children in schools, workhouses, infirmaries, etc. (*loco citato*). The figures come out thus:—number of damaged or lost eyes, 1,291; due to ophthalmia neonatorum, 113, or 8·75 per cent. The degree of damage to sight may be stated as under:

A Table showing the amount of damage to sight sustained by 113 eyes as the result of Ophthalmia Neonatorum.

Damage to Sight	1	2/3	1/2	1/3	1/4	1/6	1/10	1/12	1/15	1/20	1/30	Fingers.	Perception of light.	Eye removed.	Blind.
Eyes (113)	10	16	14	6	3	5	19	—	—	2	—	13	3	3	17

There are dangers connected with ophthalmia neonatorum altogether apart from its influence upon sight. In former times, when the malady was much more prevalent than it is nowadays, it has been known to spread to other babies, especially in foundling or in lying-in institutions or in workhouses. Many examples of this sort are scattered through the pages of the earlier writers.* A comparatively recent example is that recorded by Puech (*Montpellier Médical*, 1889, p. 272) at the *Clinique d'Accouchements* at Montpellier, France, where during November, 1888, 20 to 25 cases of ophthalmia occurred among 100 newly-born babies. W. W. Heelas (*Lancet*, April 8, 1893) has related a curious chapter in the history of the General Lying-in Hospital, Lambeth, London. The method of prophylaxis formerly adopted at that hospital included the use of sublimate lotion, 1 : 2,000, placed in

* See Dequeuauviller, *Archives générales de Médecine*, 4^e série, Tome I and II, pp. 397 and 9.

the baby's eye as soon as the lids had been cleansed, and continued twice a day during the infant's stay in the hospital. At the end of 1892 and the beginning of 1893, numerous cases of ophthalmia occurred, for which no cause could be found. Between 1st and 22nd January in the latter year, no fewer than 42 per cent. of the babies were attacked. The Credé method was then enforced, after which not a single case of ophthalmia occurred.

It cannot be doubted in the earlier days of poor-law administration, when large schools, the so-called "district" schools, were founded near London (1849-1860), that the disease was drafted into the schools from the workhouses, and there formed the starting-points of most formidable epidemics of contagious ophthalmia. Such an outbreak, originating from a baby with ophthalmia, who was not kept apart from other children, occurred at Bethnal Green Workhouse, London, in the year 1893, as the outcome of which 52 children, whose ages ranged from 2 to 15 years, were affected, to say nothing of a number of younger children, including some babies. The diseased children—at least, those of school age—were drafted to the Ophthalmic School, at Hanwell, W., an institution for the treatment of contagious diseases of the eye, of which the writer was then in medical charge. Gonococci were found in the eye discharges from all the children, several of whom manifested gonococcal vulvo-vaginitis as well as ophthalmia. In the result, one eye was lost, while five eyes sustained more or less damage to sight.

The infection of nurses who tend cases of ophthalmia neonatorum (of which the writer has witnessed several deplorable examples) is too well recognized to call for illustration in this place. The graphic account of such a case given many years ago by Gilbert Mackmurdo (*Lancet*, 1850, I, p. 658) may alone be quoted. "Recently, an old grandmother was brought to me," wrote that surgeon, "quite blind, her eyes streaming down with pus. On enquiry, I learnt that two of her grandchildren had been under my care, with purulent ophthalmia, and although their mother had been urgently requesting her own parent to avoid using the towels kept for the children, she obstinately persisted in using them, saying that 'nothing that came from the darling babe's eyes could hurt an old woman like her.' "

Every ophthalmic surgeon will admit that cases of ophthalmia neonatorum are becoming scarcer and scarcer. Speaking for myself, I used to see five cases ten years ago in London where I hardly see one now-a-days, although the amount of clinical material at my disposal has increased in the meanwhile. The returns from lying-in institutions, poor-law infirmaries, and eye hospitals all point in the same direction, namely, to the probable extinction in the not distant future of this dangerous disorder. Reduction in the number of cases implies as its necessary corollary a corresponding reduction in the blindness caused by the disease. Widmark's figures (*Centralbl. f. prak. Augenheilkunde*, September, 1895) dealing with ophthalmia neonatorum in Stockholm, Sweden, are worth quoting. In 1885, it should be explained, the Swedish Medical Society recommended the adoption of the Credé plan of prophylaxis by midwives. In the preceding year (1884) ophthalmia had formed 1.2 per cent. of all the eye cases attending the City polyclinics. The diminution during the succeeding six years was both uniform and satisfactory. It was as follows:—1885, 0.88 per cent.; 1886, 0.70 per cent.; 1887, 0.46 per cent.; 1888, 0.39 per cent.; 1889, 0.28 per cent., and 1890, 0.24 per cent. Moreover, a corresponding reduction in damage to the cornea was manifested. In 1884, that had mounted to 30 per cent. of the cases, a figure reduced to 26 per cent. in 1885, to 8 per cent. in 1887, and, finally, to 6 per cent. in 1888. In Widmark's private work the progress made was still more sensible, since for the period 1885-89 the proportion of ophthalmia was 3 per thousand, while it was only 0.4 per thousand for 1890-94.

Unfortunately, no British figures that I am acquainted with are so complete as those assiduously collected by Widmark. Still, Mules's statistics dealing with the period 1876-1885 at the Manchester Eye Hospital, given below, show that between the two years named there was a reduction in the cases of ophthalmia neonatorum presented for treatment amounting to about two-thirds. Interesting figures from Glasgow, compiled by Thomas Reid, covering the ten years, 1887-1896, point to a very distinct diminution in the disease. They are also quoted on the following page.

MANCHESTER EYE HOSPITAL.				GLASGOW EYE INFIRMARY.			
Period.	Patients	Oph-thalmia.	Per-cent.	Period.	Patients.	Oph-thalmia.	Per-cent.
1876	7477	293	3.91	1887	9,774	99	1.01
1877	8325	313	3.75	1888	10,251	82	0.79
1878	8591	413	4.80	1889	11,324	83	0.73
1879	8573	270	3.14	1890	11,753	83	0.70
1880	10,262	423	4.12	1891	12,061	61	0.50
1881	10,919	400	3.66	1892	12,261	96	0.78
1882	12,961	539	4.15	1893	13,438	93	0.69
1883	14,702	358	2.43	1894	15,267	76	0.49
1884	15,427	310	2.00	1895	16,292	125	0.76
1885	15,184	198	1.30	1896	18,111	113	0.62
Totals:—	112,421	3,517	3.12	Totals:—	130,532	911	0.69

Leslie Buchanan (*Scottish Medical and Surgical Journal*, November, 1902) has treated the abundant material of the Glasgow Eye Infirmary in an even more suggestive way, since he has compared the percentage-incidence of ophthalmia neonatorum over the several decades from the year 1860. His figures come out as under:—1860-1869, ophthalmia formed 1.3 per cent. of all patients; 1870-79, 1.01 per cent.; 1880-1889, 0.76 per cent.; and the last decade to 1899 showed a further decrease to 0.5 per cent.

Returns from the Metropolitan Poor-Law Maternity Wards point in the same direction. It will be remembered that in the figures for 1894-1895, quoted on an earlier page, the morbidity of ophthalmia neonatorum reached as high as 3.60 of all living births. Dr. Arthur Downes, Local Government Board Inspector, now informs the writer that during the three years 1903-04-05, there have been 125 cases of ophthalmia in 8,889 births, or 1.406 per cent. In other words, the prevalence of ophthalmia in these institutions has, during the last decade, been reduced by more than one-half. The diminution is, in fact, really greater than is shown by

the figures, since the 125 cases returned include many examples of trivial inflammation of the conjunctiva, and make, moreover, no distinction between "early" and "late" infections.

The Provincial Poor-Law returns also indicate a diminution in the prevalence of the disease. This may be shown by analysing the figures quoted in the table given on pages 8, 9, and 10. If we divide the figures into two equal periods, each of 5 years, from those places where they cover a period of 10 years and where the necessary details are given, we shall find that the results come out as under :

A Table comparing the Returns from Provincial Poor-Law Lying-in Wards for two consecutive periods, each of five years.

Period.	Births.	Ophthalmia.	Percentage.
1897—1901	6,021	55	0·91
1902—1906	7,205	51	0·707

Adolf Alt (*American Journal of Ophthalmology*, April, 1901), speaking of the Western States of America several years ago, said that "cases of blennorrhœa neonatorum have of late grown decidedly less frequent."

In a recent communication (*Ann. de Gynécologie et d'Obstétrique*, June, 1904, p. 336) Morax states that the last census at the Paris Quinze-Vingts made ophthalmia neonatorum responsible for only 0·6 per cent. of the blindness amongst the inmates of that institution, an estimate far removed from the 50 per cent. indicated by Magnus many years ago.

In the year 1906 (*Journal American Medical Association*, June 15, 1907), it was estimated that 7 per cent. of the blindness in the State of New York had developed from ophthalmia neonatorum.

Of the various factors making for a reduction in ophthalmia neonatorum, perhaps the most important is the well-nigh universal use in midwifery of modern antiseptic and aseptic precautions. The measures of prevention adopted in all the best maternities, moreover, are doubtless not without an influence upon the figures.

ÆTIOLGY.

In former times many causes were given to account for the ophthalmia of newly-born babies. An imprudent exposure of the infant to bright light, or to cold air, or to the heat of the fire; the intrusion of soap or of the spirit sometimes rubbed over the baby's head; a scrofulous constitution; or a disordered state of the bowels: were among some of the many things once blamed for infantile ophthalmia.

The recognition of the connection between leucorrhœa in the mother and ophthalmia in the baby, however, certainly dates back to the year 1750, when S. T. Quellmalz (*Centralbl. f. prak. Augenheilkunde*, Feb., 1894) insisted upon the point. The fact was mentioned by J. G. Goetz in 1791 (*De Ophthalmia Infantum recens natorum*), by C. G. Scle in 1793, and by A. Schmidt in 1806 (*Ophthalmologische Bibliothek* von Himly u. Schmidt, III, 2, 1806, p. 107). "I will not maintain," said the last-named author, "that the blepharoblenorrhœa of those new-born infants whose mothers have leucorrhœa is produced by direct contagion, like gonorrhœa, although I have ascertained that in many such cases discharge from the vagina exists in the mother." "I have also discovered," he continued, "in the case of female infants, that the mucous membrane of the female organs was not infrequently affected as if they had a clap."

The connection, however, was not at once admitted. Thus, writing in the year 1806, A. Edmonston (*A Treatise on the Varieties and Consequences of Ophthalmia*, p. 132) stated that ophthalmia was connected with "a loaded and oppressive state of the bowels." Loose statements of this kind may be found in works bearing a much later date, a fact the more surprising since Benjamin Gibson, surgeon to the Manchester Infirmary, stated the cause of the ailment so plainly and concisely one hundred years ago that I venture to think we could scarcely better his account even at the present day. No apology seems to be needed for recalling that pioneer's exact words, which will be found in the *Edinburgh Medical and Surgical Journal* for the year 1807, page 160. "It is most probable, however, that the usual cause of this disease," he wrote, "is furnished by a

neighbouring organ. The following circumstances suggested it to me. I was consulted some time ago in the case of Mr. C.'s child, who had lost both eyes from an attack of this disease. After some days' attendance, Mrs. C. called my attention to a complaint which had existed previous to her marriage, and had continued during her pregnancy to the present time—this complaint was *fluor albus*. The coincidence of a similar discharge in the two cases attracted my attention, and it occurred to me, that the eyes of a child, during their passage through a vagina where such a discharge was secreting, might receive the disease in question by contact between the fluid and the eyelids. Since that period, I have been as particular in my enquiries, as the delicate nature of the case will allow, respecting the state of the mother's organs, at the period of delivery, where the child has been affected with the puriform ophthalmia, and have found, with little exception, that *fluor albus* existed." Of thirty-five cases met with in the course of one year at the Manchester Infirmary, leucorrhœa was present in every one. In short, the frequent coincidence between *fluor albus* and puriform ophthalmia led Gibson to surmise that those diseases stood in the relation of cause and effect. At the same time, he expressly stated that " *fluor albus* is not the only cause of a puriform discharge from the eyes of an infant," neither did he claim that the eyes of every child who passed through a vagina affected with *fluor albus* need necessarily be attacked with puriform ophthalmia.

In the year following Gibson's epoch-making publication, we find Thomas Morrison, of Dublin, decidedly of opinion that ophthalmia neonatorum was of venereal origin (*Medical and Physical Journal*, Vol. XX, 1808, p. 57). "The following circumstance," wrote Morrison, "suggested it to me. I was consulted some years ago in the case of Mrs. N.'s child, who ultimately lost one eye from an attack of this disease. On my first days of attendance, Mrs. N. drew my attention to an affection which existed previous to her parturition, and had continued subsequently thereto; this complaint was unequivocally a case of the venereal kind, which had been suspended in its action by advanced gestation; the coincidence of a similar discharge in the mother and foetus excited my particular attention, and it occurred to me that the eyes of an infant, during their passage

through a vagina where such a purulent virus was present would be liable to receive the disease in question by contact between the matter and the eyes of the infant." Morrison continues: "To confirm the opinion I early entertained of the real nature of the complaint, I was led to adopt a very bold experiment: a little matter was applied, that issued from the eyes of Mrs. N's child, to an abraded surface on the back of the hand of a young surgeon; the result was a genuine venereal ulcer was produced, and to subdue which, the most steady administration of mercury became necessary." Morrison's views, as set forth above, were criticised by an anonymous writer, whose letter, printed on page 237 of the same volume of the *Medical and Physical Journal*, was dated from the Manchester Infirmary. That writer pointed out correctly enough, that Morrison did not discriminate between lues and gonorrhœa, but spoke vaguely of a "venereal" affection. He believed that the ophthalmia in Morrison's case arose not from any venereal, but from some virulent matter applied to the eyes of the infant during its entrance into the world. *Ophthalmia neonatorum*, in his opinion, was induced by the application of the discharge of leucorrhœa.

A year later W. Simmons, of Manchester (*Edinburgh Medical and Surgical Journal*, Vol. V, 1809, p. 283) spoke of the assumed infective origin of ophthalmia as "purely hypothetical," seeing how common leucorrhœa was, and how comparatively rare ophthalmia. In Simmons' view, the cause of ophthalmia was to be sought in "a peculiar constitution of the atmosphere."

It is curious to note, again, that seven years after the appearance of Gibson's communication, we find James Ware (*Remarks on the Ophthalmia*, 1814, p. 126), in evident ignorance of his countryman's important work, assuring his readers that "the purulent eye is usually unconnected with any other disorder."

Hegewisch (Horn's *Archiv f. prakt. Medicin*, Vol. III, p. 208) considered leucorrhœa to be the sole cause of ophthalmia neonatorum, and recommended when the disease was present that the infant's eyes should be washed with lavender water. J. C. Saunders (*A Treatise on some Practical Points relating to*

the Diseases of the Eye, London, 1811) regarded the ophthalmia of babies as an "erysipelatous inflammation of the conjunctiva" (p. 7). Siebold (1819) and Ritterich (1820), however, saw few, if any, cases of ophthalmia except in the offspring of mothers suffering from leucorrhœa.

A few years after the publication of Saunders' treatise, John Vetch (*Practical Treatise on the Diseases of the Eye*, 1820, p. 242) furnished the experimental proof of the truth of Gibson's deduction by inoculating the urethra with ophthalmic pus, and thereby inducing gonorrhœa within thirty-six hours.

In 1824, Isaac Ryall (*Trans. of the Association of the Fellows and Licentiates of the King and Queen's College of Physicians in Ireland*, Vol. IV, 1824, p. 340) said, *apropos* of the supposed origin of the disease from the maternal discharge, "certainly all the enquiries which I could make on so delicate a subject, contribute to establish this opinion." In the same year, Green (*Lancet*, February 15, 1824, p. 213) was doubtful whether ophthalmia arose from exposure of the baby's eyes to light or from inoculation during birth.

A. Watson, writing in the year 1828, stated that "the infantile ophthalmia has been considered to arise from the contact of the matter of fluor albus, imparted from the mother at the time of birth" (*A Compendium of the Diseases of the Human Eye*, 2nd edition, p. 34).

J. H. Wishart (*Edinburgh Medical and Surgical Journal*, 1829, Vol. XXXII, p. 253) after distinguishing between a mild and a syphilitic leucorrhœa, went on to state that more than two-thirds of the infants affected with ophthalmia were born of parents labouring under the first-named ailment, "though it is difficult," he continued, "to determine whether they are necessarily or only accidentally connected together."

In 1834 Arthur Jacob (article "Ophthalmia" in *Cyclopædia of Practical Medicine*, by Forbes, Tweedie, and Conolly, Vol. III, p. 198) implied that there was a close connection between purulent ophthalmia, gonorrhœal ophthalmia, and ophthalmia neonatorum. As regards the last-named disease, he distinguished a mild from a severe clinical type. The former was produced, he thought, by exposure of the infant to cold immediately after its expulsion from the uterus. On the other hand, the resemblance

between the severe form and gonorrhœal ophthalmia justified the suspicion that it was of equally distinct specific character, and to be traced to a cause equally peculiar. This cause might be the application of the matter of leucorrhœa or gonorrhœa to the eyes during labour. The extent to which this cause operated, however, had not been fully ascertained, and the proof of its existence, Jacob thought, existed more upon conjecture and reasonable inference than actual practical evidence. The practitioner, however, should be aware that in a majority of the cases of purulent ophthalmia the mother laboured under leucorrhœa or even gonorrhœa.

Hugh Carmichael (*Dublin Journal of Medical Science*, Vol. XV, 1839, p. 200) alluded to the purulent ophthalmia of infants as generally considered to arise from either of the following causes: infection from the mother at the time of birth, or the incautious exposure of the child to the influence of the cold. Subsidiary causes were scrofula, bad air, defective clothing or diet, the application of sordes or of gonorrhœal or syphilitic matter to the eye, and foul linen or sponges after birth. He devoted a good deal of space to attempting to refute the theory (which was evidently becoming accepted) that the disease was due to inoculation with the maternal secretions. Carmichael's criticisms may be shortly summed up as follows:—
1. Although ophthalmia usually appeared two, three, or four days after birth, yet it might not supervene until the twenty-first or twenty-second day, an observation that Carmichael considered incompatible with the theory of infection. 2. Ophthalmia was often met with in children whose mothers had never been affected with leucorrhœa. 3. The babies of mothers suffering from leucorrhœa generally remained free from ophthalmia. Briefly, Carmichael argued that ophthalmia neonatorum could not in fact be gonorrhœal ophthalmia in the new-born child, which it virtually must be if it arose from the matter of that complaint, since it seldom damaged the eye, while gonorrhœal ophthalmia in the adult nearly always did so. Carmichael was disposed to believe there was a close connection between derangement of the bowels and ophthalmia, and he claimed to have cured ophthalmia in its early stages by attention to the alimentary canal alone.

In 1840 we find C. Edwards (*Lancet*, July 4, 1840) claiming to be the first to distinguish between early and late infections. The former, in his view, was most frequently occasioned by the application of leucorrhœal matter to the eyes of the infant during birth, especially in cases of tedious delivery of the head. The latter Edwards attributed to some want of cleanliness in the ablution of the child or to the application of a soiled napkin or sponge to the eyes.

William Lawrence (*A Treatise on the Diseases of the Eye*, 1844, p. 221), speaking of the causes of ophthalmia neonatorum, remarked: "In a great proportion of the cases there is vaginal discharge from the mother, leucorrhœa, and sometimes gonorrhœa. The eyes of the infant are exposed to the contact of these morbid secretions in passing through the vagina; hence has arisen the natural inference that they are affected from the actual contact of this matter, and the tolerably regular appearance of the disease on the third day, corroborates this notion of contagious origin from direct application of the morbid matter."

A modest but most important communication from the pen of James Whitehead, surgeon to the Manchester and Salford Lying-in Hospital, was published in 1847, dealing with 35 cases of purulent ophthalmia in infants (*Provincial Medical and Surgical Journal*, 1847, p. 536). In every instance inflammation or ulceration of the lower part of the uterus in the mother was known to have been present previously, while all women suffered from vaginal discharge—muco-purulent in 32, and purulent, sanguino-purulent, or sanguous in the remaining 3 cases. Whitehead distinguished clearly between primary ophthalmia, which occurred from the moment of birth to the end of the fourth or fifth day, and secondary ophthalmia, which arose from the period last-named to that of ten or twelve weeks after birth or later. Primary ophthalmia was attributed by Whitehead to direct inoculation of the eyes with maternal secretions during the passage of the infant through the uterine orifice during parturition, while secondary ophthalmia depended also, but much more remotely, upon the same agency.

Sir Thomas Watson (*Lectures on the Principles and Practice of Physic*, Vol. I, 1848, p. 309) pointed out that the circumstance of the disease commencing so regularly on the third day was

greatly in favour of the supposition that it resulted from inoculation of the infant's eyes with leucorrhœal or gonorrhœal secretions from the mother. That author, however, thought that the disease might "probably" be brought on by some other causes, among which he included bad management on the part of the nurse, draughts of cold air, and exposure to the influence of a hot and bright fire.

In 1852 W. S. Oke (*Provincial Medical and Surgical Journal*, 1852, p. 29) stated, in so many words, that ophthalmia was communicated to the child by its coming into contact with specific discharge during the passage of the head through the vagina. In 1853 W. Tyler-Smith (*Lancet*, August 20, 1853, p. 157) suggested that the contagion of ophthalmia was more closely connected with the acid or epithelial secretion of the vagina in leucorrhœa than with the actual mucous-purulent secretion; and Credé in the same year (*Klinische Vorträge über Geburts.*, I, 1853, p. 160) made a substantially similar suggestion.

William Mackenzie (*Practical Treatise on the Diseases of the Eye*, fourth edition, 1854) stated that the cause of ophthalmia in infants was not uniform, but he attached great importance to leucorrhœa in the mother, and made the definite statement that the disease in its worst form was "the result of the application of gonorrhœal matter during the passage of the head through the vagina" (p. 466). Mackenzie mentioned an example of the highly contagious nature of the pus from ophthalmia neonatorum, which is so conclusive with regard to that point that it might almost be regarded as the equivalent of a scientific inoculation experiment (p. 470).

At about this period a most suggestive series of experiments was conducted by Pauli, of Landau. That surgeon placed the discharge from a case of ophthalmia neonatorum in the urethra of a man, aged 36 years, with the result that gonorrhœa appeared on the evening of the third day. Despite Pauli's warnings, the man communicated the disorder to his wife. In 1854 Pauli introduced the pus from ophthalmia neonatorum into the vagina of a prostitute, and in that way produced gonorrhœa. From his experiments Pauli concluded, logically enough, that as blennorrhagia of the conjunctiva could set up blennorrhagia of the urethra or vagina, and vice

versâ, there could be no valid reason for doubting the perfect identity of the several conditions named. In 1858 D. Guyomar (*Thèse de Paris*, 1858, p. 45) placed in his own urethra pus from the inflamed eye of a baby, aged 3 days, whose mother was affected with *fluor albus*. A severe gonorrhœa was the result, and in view of modern researches it is of interest to note that this was accompanied at a somewhat later stage by muscular rheumatism of the lumbar region which confined Guyomar to bed for several days.

After the authoritative statement of William Mackenzie, the view that ophthalmia in the baby was related to leucorrhœa in the mother, as effect and cause, became widely accepted in Great Britain. Haynes Walton, writing in 1865 (*Medical Times and Gazette*, 1865, I, p. 559) alluded to the frequency of leucorrhœa in the mothers of children affected with puriform ophthalmia, insisted on the connection between the two conditions, and made the important observation that premature babies seldom escaped maternal infection. J. S. Wells (*Lancet*, August 21, 1865) admitted that ophthalmia was generally due to the contagion of vaginal discharges, gonorrhœal or leucorrhœal, but, like Watson, claimed that external irritants, as exposure of the eyes to cold, bright light, and dust, were also common causes. He stated, however, that if the disease were due to contagion, the symptoms would manifest themselves within the first two or three days after birth. In 1866, we find Wilson (*Dublin Quarterly Journal of Medical Science*, Vol. XLII, 1866, p. 184) meeting the objection, that if the conjunctiva were capable of inoculation by maternal secretions, then we should also find the mucous membrane of the female genitals involved, by saying that those parts were, to a certain extent, naturally protected from contact with the vaginal walls, and that they were, besides, much more effectually cleansed than the eyes by immersion in water after birth. He was apparently unaware that James Whitehead writing nineteen years before (*loco citato*), had actually witnessed such inoculations in the newly-born, and, for that matter, that a much earlier author, Schmidt (*loco citato*) had mentioned the condition in 1806.

In 1872, Emil Noeggerath's work on latent gonorrhœa in women (*Die latente Gonorrhœa im Weiblichen Geschlecht*)

although received most unfavourably by the medical profession at the time, furnished later investigators with the clue to the explanation of the ætiology of many obscure cases of ophthalmia in newly-born babies. Noeggerath maintained that 90 per cent. of the cases of gonorrhœa remained uncured, and that of 100 women who married men formerly affected with gonorrhœa, scarcely ten remained healthy, the rest suffering from various induced ailments (W. J. Sinclair). Gonorrhœa might be latent in the male as well as in the female, and might then affect a healthy subject, either with the acute disorder or with a gleet. Noeggerath (*Trans. American Gynecological Society*, Vol. I, 1876, p. 268, *et seq.*) surmised that a fungus might be found "peculiar to the secretion of women affected with latent gonorrhœa." He had actually recognized such a fungus, but had failed to follow up his investigations, because he had met with a similar body in discharges from very young children, in cases of which the ætiology was obscure.

Hulke (*Medical Times and Gazette*, 1873, II, p. 629) admitted both leucorrhœa and gonorrhœa as causes of infantile ophthalmia, but expressed the opinion that when due to the latter condition, the disease of the eyes was so much the more severe.

Here and there a dissentient voice was raised against the theory of an infective origin of ophthalmia. For example, T. Ballard was accustomed to maintain that ophthalmia was due to no other cause than improper exposure of the eyes to daylight (*British Medical Journal*, 1859, p. 411), and to assert that he had banished it from his own practice by acting on this opinion (*Ibidem*, May 9, 1863). He supported his conclusion by a series of arguments that were more ingenious than convincing, and refuted the theory of inoculation on the three following grounds: first, because the disease did not appear until several days after birth; secondly, because, provided light were kept away, the children of mothers with extreme leucorrhœa did not develop ophthalmia; and, thirdly, because the offspring of non-leucorrhœal women got ophthalmia, provided there were no green blinds to the windows of the lying-in chamber. Again, Jabez Hogg (*Medical Press and Circular*, March 31, 1875) animadverted against the view that ophthalmia was still, "as in

days gone by, looked upon by some practitioners as a purulent affection, the result of direct specific inoculation, or application of puriform matter, gonorrhœal or leucorrhœal, to the eye during the passage of the head of the infant through the vagina."

Meanwhile, some observations had been made upon the frequency of maternal discharges in parturient women and their bearing on ophthalmia. One of the earliest and most important of these was conducted by Cederschjöld in the year 1832 at the Stockholm Maternity Hospital (ref. in *London Medical Gazette*, 1840, p. 382). During that year all women who presented themselves at the institution were examined, with the result that among 328 females, vaginal discharges were found to be present in 137, or upwards of 41 per cent. Cederschjöld discovered, further, that of 30 babies affected with ophthalmia, 20 were the offspring of mothers with vaginal discharge, and 10 only of the others. In other words, ophthalmia was nearly three times as common among the former (14 per cent.) as among the latter class (5 per cent.). Haussmann (*loco citato*, p. 96) found discharge of a mucous or purulent nature in 249 of 250 pregnant women of the lower class, and in 30 of 50 women of the better class. Puech (*Archives de Tocologie*, February, 1890) found more or less leucorrhœal discharge in 103 of 110 pregnant women examined by him at Montpellier.

It was now generally admitted, both in this country and elsewhere, that although ancillary causes might, and probably did, exist, yet the chief cause of ophthalmia in the infant was an infective discharge in the mother.

This was the position until the year 1879, when Neisser's announcement of his discovery of the gonococcus (*Centralbl. f. med. Wissens.*, July 12, 1879) at once broke fresh ground and widened the scientific issues. Neisser himself had found the micro-organism both in pus from the eyes of ophthalmic infants (7), and adults with gonorrhœal ophthalmia (2), as well as in the secretions from specific vaginitis and urethritis (35). He therefore concluded that the gonococcus was the cause of all the conditions named. Bokai (*Allg. med. Zentral-Zeitung*, September 15, 1880) cultivated the organism, and succeeded in inoculating it into several men. O. Haab (F. Horner's *Festgabe*, 1881) found microbes in the secretions from 11 cases.

of ophthalmia neonatorum, 5 of urethral gonorrhœa, and 2 of purulent ophthalmia, and (with a note of characteristic caution) confessed that to him the cocci in the pus from these three sources presented identical morphological characters. In a certain measure, Haab found that the number of the micro-organisms corresponded with the severity of the disease. Velpeau opposed Haab's view, that ophthalmia neonatorum was caused by inoculation by gonococci, on the ground that the baby's eyes were closed during the sojourn in the maternal passages. In the same year Hirschberg and Krause (*Centralbl. f. prak. Augenheilkunde*, 1881, pp. 39 and 270) found gonococci in all, except one, of the thirty cases of ophthalmia neonatorum that they examined bacteriologically, a fact that led them to affirm that the disease was the outcome of inoculation of the baby's eyes at the moment of birth. F. Krause (*Centralbl. f. prak. Augenheilkunde*, 1882, p. 134) in the following year cultivated the gonococcus on blood-serum, and claimed to have excited purulent conjunctivitis by inoculating the eyes of four rabbits, six to ten days old. v. Tischendorf (*Centralbl. für Gynäk.*, VIII, 1884, p. 644) inoculated the eyes of several marasmic infants with vaginal pus containing gonococci, and in every instance produced purulent ophthalmia.

Haussmann (*loco citato*, 1882, p. 62) had attached considerable importance to the lochia, which he thought might not only be conveyed direct to the infant's eyes, but which might also be carried in a dry state, as infective dust, and in either way produce ophthalmia. G. Schirmer (*Centralbl. f. Gynäk.*, 8 April, 1882) inoculated the healthy eyes of a six days' baby with lochial secretion, with the result that ophthalmia appeared some forty hours later. A pure culture of the gonococcus was, however, found in the secretion. P. Zweifel's experiments (*Arch. f. Gynäk.*, XXII, 1884, Heft 2, p. 318) went to show that the lochial secretion of healthy and recently confined women, provided it was free from gonococci, was incapable of setting up inflammation when placed in babies' eyes. He inoculated the eyes of six infants, without once producing ophthalmia, with the lochia—bloody, serous, and purulent—taken from the third to the thirteenth day after confinement. Two

of the women had formerly suffered from leucorrhœa. Zweifel concluded that ophthalmia was the result of a gonorrhœal infection, to which newly-born children were predisposed. J. A. Andrews (*New York Medical Journal*, 24th and 31st October, 1885), also, inoculated the eyes of the new-born in three cases with normal lochial secretion. The result was negative.

Kroner, on the contrary, examined the discharge from 92 cases of ophthalmia neonatorum (*Arch. f. Gyniik.*, XXV, 1885, Heft 1, p. 109) and found the gonococcus in 68.47 of them, and in 21 of the mothers of the latter babies (all he examined) he discovered the same microbe in the vaginal secretions. From the fact that in 31.53 per cent. of the cases of ophthalmia he failed to identify the gonococcus, he concluded that the vaginal secretion, although free from the gonococcus, was able under some circumstances to produce ophthalmia in the baby. Kroner's bacteriological deduction was thus in direct conflict with the earlier experimental one of Zweifel. Kroner inoculated the non-gonococcal vaginal secretion from a pregnant woman near term into the healthy conjunctival sac of five adult blind persons, but without producing any inflammatory reaction. The baby of the same woman, when born some time after the experiment had been made, remained free from ophthalmia, prophylactic treatment of the eyes having purposely been omitted.

Investigators had by this time familiarised themselves with the fact that, although the discharge from ophthalmia neonatorum in a majority of cases included the gonococcus, yet the fluid might be free from those, or, indeed, from any other, organisms.

Widmark (*Hygeia*, September, 1884, ref. in *Rev. gén. d'ophthalmologie*, 1884, p. 527) found gonococci in 19 out of 25 cases of infantile ophthalmia, and made the suggestive, though negative, experiment of inoculating the male urethra with secretion from the non-gonococcal cases without exciting inflammation.

These results were confirmed by other writers, who established the fact that the more dangerous forms of ophthalmia were practically always associated with the gonococcus, while those organisms were seldom found in the

milder cases. As to the latter point, Kroner (*Breslauer ärztl. Zeitschr.*, Nos. 20 and 21, 1884) found corneal ulcerations in 16 (25.39 per cent.) of 63 cases of gonococcal ophthalmia, while in 29 cases not associated with those micro-organisms, no single instance of corneal mischief was observed.

Meanwhile, however, it had been pointed out by Morax, Parinaud, etc., that micro-organisms other than the gonococcus, such as the pneumococcus, were now and then to be met with in cases of ophthalmia neonatorum, a point to which reference will be made later in these pages.

To sum up, it may be said that four main facts had been established thus far :—

1. That a majority of the mothers of ophthalmic babies were affected with a vaginal discharge at the time of delivery ;
2. that in most of these cases gonococci could be found not only in pus from the maternal passages but also in pus from the inflamed eyes ;
3. that micro-organisms other than the gonococcus could occasionally be demonstrated in the non-gonococcal forms of ophthalmia ; and
4. that the serious cases of ophthalmia—that is, such as were likely to imperil sight—were almost invariably due to the specific microbe of gonorrhœa.

The ground having now been cleared by the foregoing historical sketch, we may discuss the aetiology of ophthalmia neonatorum under three heads :—1. the specific elements of infection ; 2. the mechanism of infection ; and 3. the contributory factors of infection.

I.—The Specific Elements of Infection.

Let us first enquire in what proportion of cases of ophthalmia neonatorum the gonococcus has been demonstrated.

A table showing the percentage of cases of Ophthalmia neonatorum in which Gonococci have been found.

No.	Name.	Reference.	No. of cases of Ophthalmia.	Percentage with Gonococci.
1	Kroner	<i>Vers Deut. Aerzt.</i> , 1884.	92	68.47
2	Haab	<i>Corr.-Bl. f. schw. Aerzt.</i> , 1885	16	87.50
3	Weeks, J. E.	<i>Medical Record</i> , July 24th, 1886.	17	88.23

No.	Name.	Reference.	No. of cases of Ophthalmia.	Percentage with Gonococci.
4	Widmark	<i>Rev. gén. d'ophthalmologie</i> , Apl. 30th, 1888.	103	62·13
5	Andrews	<i>New York Medical Journal</i> , June 21st, 1890.	122	100·00
6	Kopfstein	<i>Wein. klin. Wochenschrift</i> , 1891, Nos. 5-8	51	58·82
7	Francisco	<i>New York Eye and Ear Infirmary Reports</i> , Jan., 1895	40	75·00
8	Grandclément	Ref. in <i>Centrabl. f. Gynäk.</i> , Aug. 24th, 1895, p. 930.	17	29·41
9	Cohn*	<i>Collective Investigation</i> , Berlin, 1896.	252	73·01
10	Reyling, F. T.	<i>Amer. Jour. Ophthalmology</i> , October, 1897.	14	71·42
11	Pukalof	<i>Vratch</i> , 1897, No. 27	57	100·00
12	Chartres	<i>Rev. gén. d'ophthalmologie</i> , 1897, p. 168.	100	44·00
13	Groenouw (1st Series)	<i>Ber. d. Ophthalm. Ges. in Heidelberg</i> , 1898.	40	35·00
14	Gonin	<i>Rev. méd. de la Suisse Rom.</i> Feb. 20th, 1899.	38	58·00
15	v. Ammon	<i>Münch med. Wochens.</i> , 1900. Band LII, 1901.	100	56·00
16	Guerola	<i>Ann. de Oftal.</i> , Nov., 1900.	25	100·00
17	Groenouw (2nd Series)	<i>v. Graef's Arch. f. Ophthal.</i> , Band LII, 1901.	100	40·00
18	Thomin	<i>Thèse de Paris</i> , 1901, p. 32	20	70·00
19	Alt	<i>Amer. Jour. Ophthalmology</i> , April, 1901.	17	52·94
20	Neisser	<i>Zeits. f. Augenheilk.</i> , June, 1901.	92	68·47
21	Haupt	<i>Klin. Monatsbl. f. Augenheilkunde</i> , 1903.	62	72·58
22	Torres, C.	Oftalmia purulenta de los recién Nacidos, 1904.	20	90·00
23	Druais, J.	<i>Thèse de Paris</i> , 1904.	63	38·09
24	Gabrièlidés	<i>Gaz. Méd. d'Orient</i> , Feb. 15th, 1905.	14	78·57
25	Usher & Fraser	<i>Royal Lond. Oph. Hosp. Reports</i> , XVI, pt. IV, June, 1906.	21	85·71
26	Augé, R.	<i>Thèse de Paris</i> , 1906, p. 33.	165	42·42

The above table shows that in the practice of 41 observers (Cohn's returns numbered sixteen), gonococci

*Cohn's table as given on page 34 of his well-known monograph (*Ueber Verbreitung und Verhütung der Augenerkrankungen der Neugeborenen*, 1896) includes 553 cases of ophthalmia with gonococci in 293, or 52·98%. But it appears that 252 cases only were examined with the microscope, and among that number, results were positive in 184, or 73·01. The returns obtained by Cohn numbered sixteen. The amended figures have been quoted above.

were found in 67·14 per cent. of the 1,658 cases of ophthalmia neonatorum. The figures ranged from a minimum of 29·41 per cent. to a maximum of 100 per cent. The differences thus brought to light are somewhat striking, a fact that may be accounted for in several ways, of which perhaps the most important are:—1. the social class of the mothers; 2. the methods of bacterioscopic diagnosis, together with the experience or otherwise of the observers; 3. the stage of the disease at which the investigation was made; and 4. the nature of the remedies employed during treatment of the malady.*

My own figures with regard to the point are as follows:— Up to the year 1898 I had examined the eye discharges from 45 cases of ophthalmia neonatorum, and had found gonococci in 30—that is, in 66 per cent. (*Ophthalmia in Newly-Born Children*, London, 1898, p. 11.) In the year 1903 I published (*Trans. Obstet. Society of London*, Vol. XLV) the details of 76 fresh cases in which gonococci were found in 41—that is, in 53·94 per cent. Since the year last-named I have examined 50 new cases, and found gonococci in 35—that is, in 70 per cent. It will thus be apparent that of my 171 cases of ophthalmia neonatorum, gonococci were present in 106, or 61·98 per cent.

The total number of cases at our disposal, then, is 1,829, of which gonococci were demonstrated in 64·56 per cent. As the figures are large, we shall scarcely err if we assume, as a working rule, that about two-thirds of all cases of ophthalmia in newly-born babies *brought to hospital* are associated with, and due to, the micrococcus of gonorrhœa. The importance of this generalisation lies in the fact, which has been already mentioned, that in ophthalmia the cornea suffers comparatively seldom unless gonococci be the cause of the conjunctival inflammation.

On the other hand, investigations have been carried out in various quarters for the purpose of ascertaining in what proportion of women, pregnant and otherwise, the gonococcus could be found. For example, Leopold and Wessel (*Arch. f. Gynäk.*, XXIV, 1884, Heft i, p. 89) examined the vaginal secretions of

*Dorland Smith (*Archives of Ophthalmology*, XXXIV, 1905, p. 481) has surmised that vaseline, which is much used in conjunctival infections, may interfere with bacteriological examination of pus-films. It accounted, Smith thought, for his not infrequent failure to find gonococci in cases of ophthalmia neonatorum.

eighteen women, and found the gonococcus in one alone. None of the babies born to these females were treated prophylactically, and it was most significant that one only, the offspring of the woman with gonococcal discharge, developed ophthalmia. Oscar Oppenheimer (*Arch. f. Gynäk.*, XXV, 1885, Heft 1, p. 57) amongst 108 inmates of the Heidelberg Maternity Hospital, discovered gonococci in 30—i.e., in 27·7 per cent. He obtained the material for his investigations by scraping away secretion from the upper parts of the vagina with a kind of Desmarres's lid retractor. Krönig found the gonococcus in 11 per cent. of the 496 cases in which he examined the lochia of normal puerperia. Lomer (*Deutsch. med. Woch.*, 1885, No. 43) demonstrated the gonococcus in nine out of thirty-two pregnant women admitted to Schröder's klinik—i.e., in 28·5 per cent.

Schwarz (*Sammlung klinische Vorträge*, Leipzig, 1886) found gonococci in 77, or 12·7 per cent., of 617 women examined by him. Sänger (*Verhandlungen der deutschen Ges. f. Gynäk.*, 1886) found that of 389 pregnant women 100 had a purulent vaginal discharge—26 per cent., and made the additional and suggestive observation that 40 of the babies ultimately born of the blennorrhagic females suffered from ophthalmia neonatorum. J. Zwow (ref. in *Rev. générale d'ophthalmologie*, 1888, p. 28) found gonococci in 75 of 130 pregnant women, and noted that some of the females presented no clinical evidences of blennorrhagia. Steinbüchel (*Wiener klin. Wochenschrift*, 1892, Nos. 21 and 22) investigated 328 pregnant women, and found blennorrhœa in 21·34 per cent.—namely, in 6·7 per cent. gonococci and clinical symptoms, in 0·30 per cent. gonococci without clinical symptoms, and in 1·563 per cent. clinical symptoms but no gonococci. Of the children of the diseased women 4·28 per cent. were affected with virulent ophthalmia. Carry (*Lyon Médical*, January 15th, 21st, and 28th, 1894), discovered gonococci in about 33 per cent. of the 278 loose and fallen women suffering from vaginal discharges, examined by him during a period of four years in the Sanitary Service of the City of Lyons, France. Bumm (*Centralbl. f. Gynäk.*, No. 45, 1897), found the gonococcus 11 times in 196 labours. Van Schaick (*New York Medical Journal*, 1897, p. 598) drew attention to the frequency of gonococci in married women suffering from

leucorrhœa. He examined bacteriologically scrapings from the vaginal rugæ and neighbouring parts in 65 women, and found gonococci in 26 per cent. It is important to note that the patients were all of fair social status, and that no woman whose position "made her infection a professional perquisite was knowingly included in the list."

As regards puerperal infections, Krönig found gonococci in 27 per cent. of the 179 cases of mild puerperal endometritis which he examined bacteriologically. W. Williams examined the uterine lochia in 151 cases of puerperal fever, and found the gonococcus in 5·29 per cent. Lastly, Vogel discovered gonococci, pure or mixed with streptococci, in four cases (12 per cent.) in a series of twenty-four patients suffering from puerperal infection.

In the following table are incorporated the figures quoted above with regard to the prevalence of the gonococcus in various kinds and conditions of women :

A Table showing the proportion of cases in which Gonococci have been demonstrated in married women, loose women, pregnant women, and in puerperal infections.

Condition.	Number of Cases.	Percentage with Gonococci.
Puerperal infections	354	14·763
Pregnant women	1,101	18·43
Married women with fluor albus	65	26·00
Loose women with fluor albus... ...	278	33·81

Figures, mostly obtained before the discovery of the gonococcus in 1879, are on record to show in what proportion of cases the mothers of ophthalmic babies suffered from vaginal discharge. There is no need to detail these statistics, which have been mentioned on an earlier page (31), since the viewpoint has materially changed since they were compiled. It will suffice to state that, roughly speaking, such discharge exists in two-thirds of the cases.

It would be a mistake to assume that acute or sub-acute gonorrhœa is present at delivery in most of the women whose

babies subsequently develop ophthalmia. A history of profuse yellow genital discharge and scalding during micturition and local discomfort—in a word, the obvious symptoms of a recent gonorrhœa—was obtained in 17 per cent. only of my cases.* In another 50 per cent. the history was merely of a slight fluor albus, to use the old name. In many of the latter, and in some of the remaining cases, which formed 33 per cent. of the total number, the underlying condition was probably a specific endometritis or endocervicitis, the organisms producing and perpetuating which had remained latent until roused into activity by the complicated nutritional processes involved in childbirth. As A. W. W. Lea has remarked (ref. in *Amer. Journ. of Obstetrics*, Vol. XLIII, 1901, p. 256), "Pregnancy, labour, and the puerperal state are likely to cause a recrudescence of an old gonorrhœa." W. E. Fitch (*Amer. Gyn. and Pediat.*, September, 1903), indeed, makes the definite statement that gonococci, after lying dormant in the genital tract even for years, may spring into new life under the influence of the pregnant state, and cause a severe ophthalmia neonatorum. J. E. Weeks (*Medical Record*, July 24, 1886) emphasised the chronicity of gonorrhœa in females, and explained these cases by assuming that the mothers had experienced the acute symptoms of gonorrhœa years before they became pregnant. As will be shown later, Weeks might have added that acute symptoms need not necessarily ever have been present, or if they had been present, might have passed unperceived.

Menstruation appears to have a somewhat similar effect, since relatively few gonococci, according to W. L. Burrage (*Boston Medical and Surgical Journ.*, February 7, 1901) may be present at the intermenstrual times, although they may become numerous at the menstrual period. This may account for the widely-spread vulgar belief that intercourse with a menstruating female may communicate gonorrhœa to a man.

The figures dealing with pregnant women give 18.43 per cent. as the proportion in which gonococci were present, an estimate that accords with Fruhinsholz's statement,

*Of twenty women with ophthalmic babies Groenouw (*v. Graefe's Archiv f. Ophthalmologie*, Bd. LII, 1901, p. 28) observed pain during micturition in 15 per cent. only of his cases, notwithstanding the fact that all the women suffered from vaginal discharge containing gonococci.

namely, that, on the average, gonoeocci are present in from 20 per cent. to 25 per cent. of pregnant females (*Ann. de Gynécologie*, Oct.-Nov., 1902). That the organism should occur in so large a proportion of pregnant women, apparently often without definite clinical evidences of infection, logically, at all events, makes the adoption of some measure of prophylaxis against ophthalmia a necessity in every case. It proves how weak is the position of some authors who recommend the use of the Credé method, say, only when "there is any reason for believing that the mother has gonorrhœa" (J. W. Williams, 1906).

An exacerbation of pre-existing gonorrhœa has been known to occur under widely different circumstances. Thus, Niebergall (*Beitr. z. Geb. u. Gyn.*, Bd. II, Heft I, p. 52) has reported four cases in women, in whom no signs of gonorrhœa could be discovered, neither could gonoeocci be identified. In each instance an explosion of gonorrhœa, associated with gonococci, was excited by mechanical irritation—e.g., curettage or dilatation of the uterine cavity—thereby proving more or less conclusively that gonorrhœa must have lain latent all the time. Emil Noeggerath (*Trans. Amer. Gynecological Society*, Vol. I, 1876, p. 268 *et seq.*) saw attacks of non-puerperal perimetritis, symptomatic of latent gonorrhœa, follow the most varied exciting causes—as, for example, exposure to cold or wet, protracted exertion, shock, fright, the introduction of instruments or of medicaments into the uterus, or incision of the os externum. Other exciting causes mentioned by Noeggerath included the appearance of menstruation, the bi-manual examination of the internal genital organs, and the act of cohabitation after the prolonged absence of a husband. William J. Sinclair has mentioned analogous cases in his well-known articles "On gonorrhœal infection in women" (*Medical Chronicle*, Vol. VI, 1887). Two of these may be briefly outlined:—(1) A servant maid, aged 19 years, had suffered for six months from a gonorrhœal affection, characterised by hypertrophy of the uterus and enlargement of the ovaries. Under anaesthesia, the pelvis was explored and a sterile steel sound passed. Hot douches were also employed. Next day the temperature began to rise, and this was followed by pelvic peritonitis and fixation of the uterus. The patient

ultimately died from exhaustion. (2) In Sinclair's second case the passing of the uterine sound was the only ascertainable cause for the lighting-up of a fresh attack of ovaritis, in a patient who had been affected with gonorrhœa twelve months previously.

It is, again, a fact well-recognised by surgeons that in men who have suffered from gonorrhœa, but whose symptoms have disappeared and whose urethra contains no gonococci, an exacerbation of infective gonorrhœa may follow a bout of drinking, excessive coitus, or other form of excitement. An anonymous correspondent of the *Provincial Medical and Surgical Journal*, writing in the year 1846 (p. 586), made the following significant statement: "I have often met with cases in my own practice when a man has consulted me for gonorrhœa; he has communicated the infection to his wife, who was then pregnant; both were to all appearances cured. At the birth of the child—months after—it has had gonorrhœal ophthalmia, and the mother gonorrhœa again." Credé in 1881 (*Arch. f. Gynäk.*, Band XVII, p. 50) stated that the powers of infection persisted long after the specific gonorrhœal appearances had disappeared, so that even in cases almost free from inflammation, vaginal infection might occur, and manifest itself during the first few days of life as an inflammation of the baby's eyes. H. Fritsch (Ref. in *Centralbl. f. Gynäk.*, No. 31, 1897) appears to have established the fact that latent gonorrhœa in the man may induce the same disorder in the woman, without any acute symptoms. The endometrium may alone be attacked by the disease. Pregnancy may proceed uninterruptedly in such a case, but in the puerperium slight fever may be observed and gonococci be found in the lochia. In such a case mentioned by Fritsch, the baby developed gonorrhœal ophthalmia on the fifth day, and gonococci were found in the discharge from the cervix but not in that from the urethra.

The following case, reported by Hugh Young (*Amer. Journ. of Obstetrics*, Vol. XLIX, 1904, p. 168) bears upon this residual type of gonorrhœa and its dangers as regards other persons. A man was treated for gonorrhœa for three or four years, and the patient postponed his impending marriage for a couple of years longer, in order to avoid any risks. Finally, he married, but

not until negative results had been obtained from his urethra, both by cover-slip preparations and by cultures. Six weeks after the wedding, his wife was admitted with acute tubal disease and peritonitis, requiring laparotomy and salpingectomy. John Phillips, speaking of residual gonorrhœa and its consequences (*Outlines of the Diseases of Women*, 1906, p. 190), says: "This may be the result of latent gonorrhœa in the male, *i.e.*, where a man has contracted gonorrhœa, and thinks he is cured: he may be married as late as two years afterwards, and the excitement of sexual congress set up a gleet which has the virulent infective powers of gonorrhœa, and communicate to the woman a disease indistinguishable from that disorder." In a recent discussion at the Hunterian Society on gonorrhœa (*Lancet*, November 24, 1906, p. 1,445) James MacMunn related a case in which a man had infected his wife fifteen years after contracting gonorrhœa himself.

As regards the influence of residual gonorrhœa upon the production of ophthalmia, a remarkable case was reported some years ago by Gayet (*Lyon Médical*, 1886, Tome 51, p. 350). A baby developed ophthalmia on the second day, and micrococci were found in discharge from the eye. Gonococci were demonstrated eleven days after the confinement in the mother's vaginal secretion. When questioned, the father admitted gonorrhœa ten years before—*i.e.*, five years prior to his marriage—and gonococci were found abundantly in the "goutte militaire" from which the man had suffered ever since. Another striking case has been reported by H. V. Würdemann as occurring in the practice of a friend and vouched for by the latter (*Journal of the American Medical Association*, April 8, 1893). A man, apparently quite cured of gonorrhœa six months before his marriage, begot a child after upwards of a year's cohabitation with his wife, who was in good health. The infant developed severe ophthalmia neonatorum. When the baby's eyes were almost well, the father presented himself with acute urethritis, absolutely denying any exposure to infection. "The man," as Würdemann remarks, "had probably never been cured of his first gonorrhœa."

In the following cases the present writer has met with something of the kind:—

Case No. 1.—A baby girl, aged 23 days, was seen in July, 1902, suffering from ophthalmia neonatorum, in the discharge, from which, despite repeated and careful search, gonococci could not be found. The left cornea, however, was hazy and its pupillary region covered with a greyish ulceration. The ophthalmia had commenced on the second day after birth, the circumstances of which had presented nothing out-of-the-common. The previous baby had been affected with ophthalmia. The father, in whose word I had every confidence, assured me that he had been exposed to no recent infection, although he had suffered from mild gonorrhœa several months before his marriage three years previously.

Case No. 2.—Baby P —, aged 12 days, developed bilateral ophthalmia on the third day after birth. Corneas clear. Gonococci numerous in the discharge from the eyes. The first child. The mother suffered from slight fluor albus, but had never had any symptoms indicative of acute gonorrhœa. The father, who had been married for eighteen months, had been affected with acute gonorrhœa a year before marriage, and a slight gleet had persisted almost up to the time of his marriage.

The views expressed above with regard to the latency of gonorrhœa—which are, I believe, substantially in accordance with the teachings of modern gynaecology—are supported by the occurrence of ophthalmia in successive children of one and the same mother. The existence of such cases has been recognised for many years. Thus, in 1846, an anonymous correspondent published in the *Provincial Medical and Surgical Journal* (p. 586) an interesting observation bearing on this point. He was called to a baby who had developed gonorrhœal ophthalmia on the third or fourth day, and he found a little brother, aged 2½ to 3 years, blind from purulent ophthalmia, playing on the floor. This child, like the new baby, had developed ophthalmia three or four days after birth. The mother and father had had gonorrhœa long before the birth of the first child. James Whitehead (*Provincial Medical and Surgical Journal*, 1847, p. 536) published long ago some striking figures in respect of this point. In his list of thirty-five cases of ophthalmia neonatorum he showed that 11 only of the multiparous mothers, who formed 97·14 per cent. of the total number, had not had ophthalmia in former children. The number of babies thus affected had ranged in individual instances from 3 to 8. In 1853 a rather important case of this sort was published by W. Tyler-Smith (*Lancet*, August 20, p. 157), inasmuch as eight years had elapsed between the birth of two babies, both of whom were affected with severe ophthalmia soon after they entered the world. Maekenzie on page 472 of the fourth edition (1854) of his classical *Treatise* said: "In several instances I have known ophthalmia attack one child after another of the

same parents. Such cases I suspect to be generally leucorrhœal." Blaschko (*Medicin. Central-Zeitung*, No. 98, 1856) mentioned the fact that in five of six children born of a woman suffering from leucorrhœa, ophthalmia developed soon after birth. Haynes Walton knew of the cases, for writing in 1872 (*Medical Times and Gazette*, Nov. 9, 1872), he said: "Some mothers with leucorrhœa infect all their children." Flesh (ref. in *Centralbl. f. Gynäk.*, April 15, 1882) mentioned ophthalmia in the children of the same mother. Nieden (*Klin. Monatsbl. f. Augenheilkunde*, XXIX, 1891, p. 353) observed ophthalmia attack turn by turn all five babies, born within the space of $6\frac{1}{2}$ years, of a Jewish couple of good social standing. Despagnet (*Annales d'oculistique*, Tome 115, 1896, p. 356) mentioned three consecutive cases of ophthalmia in the babies of one woman. Hermann Cohn (*Ueber Verbreitung u. Vehütung der Augenerkrankung der Neugeborenen*, 1896, p. 35) made enquiries with regard to the point. Replies were received from 15 of his colleagues whom he had circularised. From these returns it appeared that 39 mothers had already borne ophthalmic babies. In Haas's case (mentioned by Cohn), no fewer than eight children of one mother had been affected in this way. F. T. Reyling (*American Journal of Ophthalmology*, October, 1897), in a series of 14 cases of ophthalmia neonatorum, obtained a history of former infections twice, *i.e.*, in 14·28 per cent.

Groenouw in 1901 (v. Graefe's *Archiv. f. Ophthal.*, Band LII, Heft 1, p. 63) was in a position to quote some interesting figures with regard to this point culled from a series of 100 cases of ophthalmia neonatorum. In five instances he obtained a history of ophthalmia in former children, not necessarily of successive births. Thus, in two cases the third and the fourth babies were affected; in one the first and the sixth; in one the third and the fifth; and in one the third and the fourth. It may be noted that whereas gonococci were present in 41 per cent. of the entire series of 100 cases, they were found in one alone (20 per cent.) of these five cases. E. Andrade (*American Journal of the Medical Sciences*, 1902, p. 284) mentioned a case where three successive children of the same parents showed symptoms of ophthalmia shortly after birth.

As to the relative frequency of these interesting cases my

own figures are unfortunately far from complete, for two reasons :—1. the enquiry was not made in every instance ; and 2. at hospital I seldom see the parents of the diseased babies, who are nearly always brought for advice by a relative, friend, or neighbour. I give the figures accordingly with some little reserve, although one thing is certain—namely, that they understate rather than overstate the frequency. They are as follows : among the 171 cases of which I have notes, a history of ophthalmia in former babies was obtained 15 times—that is, in 8·77 per cent.

These successive infections can, in my opinion, be explained only by assuming that the mother suffers from a quiet and very chronic endocervicitis or endometritis of gonorrhœal origin, which is roused into activity by the great changes occurring during the processes of successive gestations or parturitions. Some of Groenouw's observations appear to place difficulties in the way of accepting a residual gonorrhœa as the cause of the ophthalmia, since according to that view, infection, as in most of the cases mentioned above, should be continuous. Groenouw's silence with regard to particulars of labour in the cases, use of instruments, and the maturity or otherwise of the babies, leave us without data on which to attempt to explain the apparent contradiction afforded by his figures. The statistics probably indicate that the problem is more complicated than would at first appear, and that factors of which we are as yet in almost complete ignorance take some share in predisposing to inflammation of the infant's eyes. A. Fruhinsholz (*Ann. de Gynécologie*, Oct.-Nov., 1902) has recently insisted upon the fact that parturient women with pre-existing gonorrhœa are exposed not only to the danger of the old mischief flaring up, but also to the extension of the acute inflammation to the adnexa and peritoneal cavity. It is difficult to explain why the gonorrhœal process should be revivified by some pregnancies and not by others, and yet we are forced to assume that to be the case.

Personally, I met with a very remarkable case several years ago :

Case No. 3.—A widow, aged 34 years, brought her baby, then in the third week of life, for advice on account of bilateral ophthalmia, associated with numerous gonococci in the conjunctival secretion, which was thick and yellow. The cornea were clear. The case was not specially severe. The mother informed me that each

of her previous three children had developed ophthalmia within a few days of birth, the symptoms being exactly like those shown by the present patient. Her husband, who had been dead some eighteen months, was known to have suffered from gonorrhœa a few months before his marriage. The woman herself complained of nothing beyond an occasional attack of the "whites."

The foregoing case appears to me to be significant from the standpoint of the connection between residual gonorrhœa and ophthalmia. A woman, evidently infected with gonorrhœa by her husband soon after marriage, bears three children, all of whom suffer from ophthalmia neonatorum. She then has another baby by some other man, and that infant in its turn develops ophthalmia, proved bacteriologically to be of gonorrhœal origin. Aside from a fallacy, too obvious to be mentioned, it is almost impossible to resist the conclusion that in this woman the specific organism had lurked for several years in the recesses of the mucous membrane of the cervix and uterus, or elsewhere, only to be roused into pernicious activity by each successive labour.

It is, indeed, small wonder that we so often fail altogether in obtaining from the mothers of our ophthalmic babies any history of gonorrhœa. The symptoms, doubtless, are often sub-acute, or even chronic, from the outset. When it is remembered, too, as pointed out by H. Fritsch (*Zeitschr. f. prak. Aerzte*, 1897, No. 1), that chronic latent gonorrhœa in the male may produce its like in the woman without any acute symptoms, it becomes easy to understand that the female often remains in complete ignorance of her own infection. During the puerperium, however, fever may supervene, gonococci be found in the maternal discharges, and the baby develop ophthalmia, as in a case reported by that author. Moreover, as Finger (*Wien. klin. Wochenschr.*, 1897, No. 3) says, gonorrhœa in the female is often unrecognizable clinically, and gonococci may be found even in a perfectly clear and watery urethral secretion.

The following case, reported more than thirty years ago by Angus Macdonald (*Edinburgh Medical Journal*, June, 1873), in the course of a communication upon "Latent gonorrhœa in the Female Sex," is a good example of what I conceive to be the mode of infection in the common run of cases of ophthalmia neonatorum.—A man contracted gonorrhœa in July, and had no intercourse with his wife for six or eight weeks, at the end of which time he believed himself to be cured of the disorder.

During the first fortnight in September, however, he occupied the same bed as his wife. There followed on this intercourse as regards the wife a good deal of vaginal discharge, along with some swelling of the genitals, and slight pain on making water. No further sexual intercourse took place previous to the birth of a male child on the 22nd of December. The baby developed ophthalmia after five or six days, and the disease was severe enough to blind one eye and to endanger the other almost to the extinction of sight. On the seventh day after labour, the mother developed severe pain in the left iliac region, with fever, and a pulse of 110. After lasting for four or five days, these symptoms subsided, leaving the organs of generation normal, so far as could be ascertained by clinical investigation.

In my opinion, a majority of the cases of gonococcal ophthalmia are to be explained in the following way:—A man contracts gonorrhœa, and thinking he is cured, marries a pure woman. In this way he infects his wife either with an acute or, more often possibly, with a chronic gonorrhœa. The symptoms of the latter may well pass unperceived, while those of the former may, by innocent women, be thought to be among the natural consequences of marriage, as in a case mentioned by Röhmer (*Annales d'oculistique*, December, 1894). Under any circumstances, the mischief becomes more or less limited to the urethra, the peri-urethral glands, and the cervix uteri, and remains quiescent until provoked into activity by the processes attendant upon birth.* It may then manifest itself by ophthalmia in the infant or by a rise of temperature as regards the mother, or by both events. There can, in fact, be no better evidence of gonorrhœa in the mother than gonococcal ophthalmia in the baby.

The views brought forward in the foregoing pages are strangely at variance with those expressed by Dudley S. Reynolds (*Journ. Amer. Med. Association*, January 11, 1896). That writer first argues (apparently in ignorance of the fact that at least one-half of the cases of ophthalmia neonatorum are proved bacteriologically to be due to the gonococcus) that inoculation of the infant's eyes with staphylococci, conveyed by the ignorance or carelessness of the nurse when washing the baby,

*It has even been suggested by Jadassohn (*Corr.-Blatt f. schw. Aerzte*, May 1, 1898) that some chronic gonorrhœas may be rendered acute by superinfection with their own gonococci. This may be a factor in the infection of the baby's eyes.

constitutes a vastly more common source of infection than any possible gonorrhœal state of the maternal passages. Reynolds then goes on to claim that gonorrhœa is most likely either to prevent conception in a woman, or else to provoke abortion or miscarriage, while it is rare, he thinks, for the female to contract gonorrhœa in the advanced stages of gestation, "yet this," he continues, "would appear to be the only class of cases in which gonorrhœal ophthalmia neonati might be possible from maternal infection." Reynold's opinions find their refutation in certain facts supplied by a contemporary and countryman of his own, Frank van Fleet, who in describing eight cases of ophthalmia, occurring in his private practice, wrote, "the fathers of five of the eight patients had urethral gonorrhœa, and admitted the possibility of having infected their wives a short time before their confinement" (*Post-Graduate*, December, 1899, p. 981). As to Reynold's statement that gonorrhœa is likely to provoke abortion or miscarriage, the words of a prominent American obstetrician, Andrew F. Currier, may be quoted on the point. "Should gonorrhœa," wrote Currier (*New York Medical Journal*, October 17 and 24, 1885), "supervene after pregnancy has been established, I have never seen that it exerted an influence upon the mother severe enough to produce miscarriage, nor upon the foetus any that was analogous to that of syphilis" (p. 453). Fruhinsholz, again, does not believe abortion or premature births to be relatively more common in gonorrhœal than in other women, and he expressly states that gonococcal cervicitis does not exclude pregnancy (*Ann. de Gynéc.*, Oct.-Nov., 1902). Erb (*Münch. med. Wochenschr.*, November 27, 1906) investigated 370 marriages in which the husbands had suffered from gonorrhœa, and found that 68 per cent. had two or more children, and 25 per cent. four or more.

Apart from the gonococcus, the other micro-organisms that have been found in ophthalmia neonatorum are the following, alone or mixed with other microbes. That harmless saprophyte, the xerosis bacillus, is often present, and, so far as we know, has nothing whatever to do with the causation of the conjunctivitis.—1. Pneumococcus; 2. *Bacterium coli*; 3. Koch-Weeks' bacillus; 4. Morax-Axenfeld diplobacillus; 5. Klebs-Löffler bacillus; 6. Pneumo-bacillus; 7. Influenza and pseudo-influenza bacillus; 8. Common pyococci; 9.

Streptococcus pyogenes; 10. Streptobacillus; 11. Micrococcus luteus; and 12. Bacillus pyocyaneus.

As the subject is one of some importance from an aetiological standpoint, it may not be a waste of time to trace briefly the connection between each of the organisms named and the ophthalmia of babies.

1. *Pneumococcus*.—It is perhaps a little difficult now to decide whether to Parinaud or to his pupil, Victor Morax, should be assigned the credit of having been the first to find pneumococci in the pus from ophthalmia neonatorum. Morax (*Thèse de Paris*, 1894, p. 93), however, described such a case in a baby, aged 8 days, brought to Parinaud's *clinique* in September, 1893. One eye alone was affected, and the inflammatory symptoms, which had existed for two days, were of a mild character. Pneumococci were found in cover-glass preparations and in culture from the discharge from the eye. Injection of a bouillon culture of the organism killed a white mouse speedily, and capsulated cocci were found in the heart-blood, the spleen, and the liver of the animal. Parinaud (*Annales d'oculistique*, December, 1894) characterised this form of disease as less grave than purulent ophthalmia, from which it was to be distinguished by the abundant flow of tears and by its constant association with coryza. Pneumococci were to be found both in the eyes and in the nose. The conjunctivitis generally resulted, Parinaud thought, from a nasal infection, although he admitted that bilateral cases, commencing a few days after birth, were due to maternal contamination. Gasparrini (1894), Axenfeld (1896), Schuhl (1897), Gonin (1899), Groenouw (1899), v. Ammon (1900), Alt (1901), Brewerton (1903), W. B. I. Pollock (1905), and Augé (1906), all described ophthalmia in the newly-born associated with pneumococci. With regard to frequency, it may be noted that Gonin found four such cases in 38 cases of ophthalmia (10.52 per cent.); Groenouw* 5 in 40 (12.50 per cent.); v. Ammon 15 in 100 (15 per cent.); Alt 4 in 17 (23.52 per cent.); Druais 4 in 63 (6.34 per cent.); Pollock 3 in 18 (16.6 per cent.); Moreau and Grandclément 1 in 3 (33.33 per cent.); and Augé 10 in 165 (6.06 per cent.). The

* In Groenouw's second series, that dealing with 100 cases of ophthalmia neonatorum (*Archiv für Ophthal.*, 1901, p. 21), pneumococci were found pure in 5 cases, and associated with gonococci in one case—that is, in 6 per cent.

figures quoted show that in the experience of the nine observers named, pneumococci accounted for no inconsiderable number (10·36 per cent.) of the cases of ophthalmia neonatorum. We may conclude, therefore, that, next to the gonococcus, the pneumococcus is the commonest micro-organism associated with ophthalmia neonatorum, although it is somewhat curious that in Haupt's series of 62 cases, no instance of pneumococcal ophthalmia was included (*Klin. Monatsbl. f. Augenheilk.*, 1903, XLI, Bd. 2, p. 447). Personally, I have met with a number of these cases,* which, in my experience, have always been of a mild nature, without corneal complication. They possess no clinical features to distinguish them from acute catarrhal ophthalmia as it occurs in older children. I was impressed, as some others have been, with the coryza often associated with the conjunctivitis and the ease with which pneumococcal ophthalmia could be cured. As v. Ammon (ref. in *Centralbl. f. Gynäk.*, Oct. 14th, 1899) has correctly observed, these cases often improve more or less suddenly after lasting for four or five days. There is, in fact, a kind of crisis comparable with the crisis of acute lobar pneumonia. At the same time it must be remembered that in at least two cases, those published by Gasparini (*Annali di Ottal.*, 1894) and by Moreau and Grandclément (*Rev. générale d'ophthalmologie*, Decembre, 1906), the ophthalmia ended disastrously.

We must assume that ophthalmia occurring within the first three or four days of life, and associated with pneumococci, is due to inoculation of the baby's eyes with that organism at birth. Yet it is a somewhat curious fact that, to judge from published bacteriological examinations, the pneumococcus is by no means a common inhabitant of the female genital tract. Menge and Krönig (*Bakter. des weiblichen Genitalkanale*, 1897) failed to find it once in the course of their numerous investigations. On the other hand, it was identified on a single occasion by Doyen in the healthy vagina. Several authors, as Witte, Hartmann, Morax, Zweifel, Frommel, and Wertheim, have found the pneumococcus in cases of salpingitis.

*A glance at the nineteen personal cases of ante-partum ophthalmia tabulated on page 106 will show that pneumococci were present in two of them, or 10·53 per cent. of the series.

Foulerton and Bonney (*Trans. Obstet. Society of London*, 1904, p. 128) have recently published a case of puerperal fever, due, in their opinion, to the diplococcus pneumoniæ. There was no evidence of lung affection, either during life or after death. The authors believe that the infection was a primary one of the genital passages with pneumococci.

It is known that the pneumococcus may give rise to a non-specific urethritis in the male (*Syphilology*, by C. F. Marshall, 1906, p. 424).

It is possible, as Cramer suggests (*Centralbl. f. Gynäk.*, Oct. 14th, 1899), that in some instances the eyes of the child may become infected by the saliva of the mother, nurse, or friends.

2. *Bacterium Coli*.—Cases reported by Finger (1889), Janet (1894), Josipovice (1896), and others, show that the colon bacillus may be present in urethritis when the gonococcus is absent.

Moreover, it would appear from the researches of Menge and Krönig (*loco citato*) that the organism is a common inhabitant of the genital tract of puerperal women. F. W. N. Haultain (*Lancet*, June 26th, 1897, p. 1745) found in a case of puerperal fever streptococci and bacillus coli in the cervical discharges, and also discovered the organism last-named in blood drawn from the patient's finger. Foulerton and Bonney (*loco citato*) in 54 cases of puerperal infection, found the organism in 17 cases, associated in every instance with other microbes, as streptococci, staphylococci, *B. pyocyanus*, and *micrococcus pneumoniæ*.* The same authors came across the organism twice in the vaginal secretion taken from twelve normal puerpera—once in pure culture and once with the *staphylococcus albus*. It may be noted as a point of some interest that they also succeeded in demonstrating the colon bacillus in the cervical secretion of non-pregnant women affected with leucorrhœa. Lastly, A. W. W. Lea (*Trans. Obstet. Society of London*, Vol. XLVII, 1905, p. 1) found the colon bacillus and streptococci in pus from a small uterine myoma that had caused sepsis in a primipara after delivery of a macerated full-term foetus. It should also be added that the organism was found by J. N. Hall (*Amer. Journ. of Obstetrics*,

*In a series of 49 cases of puerperal septicæmia, A. Knyvett Gordon (*Lancet*, March 30, 1907), in cultures made from the interior of the uterus, found bacillus coli communis in six cases, *viz.*, alone once and associated with streptococci five times.

1901, Vol. XLIV, p. 137) as a pure culture in a false membrane in a patient's vagina, and that its presence is widely recognised as a factor in the production of the curious condition, physometra, or distension of the uterine cavity with gas.

It may be therefore accepted that the colon bacillus may be found both in the male urethra and in the female genital tract, a fact that will prepare readers to learn that it may also occur in the eyes of newly-born babies.

In point of fact, the bacterium coli has been found in cases of ophthalmia neonatorum by several observers, including Axenfeld, Cramer, Bietti, Groenouw, Alt, zur Nedden, Haupt, McKee, and myself. Infection from the contents of the rectum is probably the cause of some of the cases.

Axenfeld (*Münch. med. Wochenschr.*, No. 19, 1898) reported in the year 1898 a case of ophthalmia associated with the colon bacillus. In Groenouw's series of 40 cases of ophthalmia in babies (*Bericht der Ophthal. Gesellsch.*, Heidelberg, 1898) an organism belonging to the colon group was found thrice in pure culture, and a like number of times associated with gonococci. As regards the former, Groenouw looked upon the bacillus as the cause of the conjunctival inflammation. The clinical picture he spoke of as being partly that of a mild or severe catarrh, and partly that of a mild blennorrhœa. Cramer's two cases (*Arch. J. Gynäk.*, Vol. LIX, 1899, p. 185) were reported in the year 1899, but no particulars were given of them. In the same year Bietti (*Klin. Monatsbl. f. Augenheilkunde*, September, 1899) published an account of a unilateral case of ophthalmia neonatorum, associated with the colon bacillus in large numbers. Under the use of a 2 per cent. solution of silver nitrate, it was cured in eight days. Groenouw, in his series of 100 cases (v. Graefe's *Arch. für Ophthal.*, Vol. LII, 1901, p. 46), found bacillus coli 11 times—7 practically pure, and 4 mixed with other micro-organisms. A. Alt (*American Journ. of Ophthalmology*, April, 1901) found the bacterium coli once in 17 cases of blennorrhœa neonatorum. zur Nedden (*Klin. Monatsbl. für Augenheilkunde*, 1902, Vol. I, p. 1) met with the organism in a case of blennorrhœa neonatorum. Haupt (*loco citato*, p. 460) found bacterium coli once in his series of 62 cases of ophthalmia. S. H. McKee (*Montreal Medical Journal*, October, 1906) met with a severe unilateral case of ophthalmia

in an infant of four days, where media inoculated with discharge from the inflamed eye gave growths of the bacillus coli, together with a few colonies of the ubiquitous xerosis bacillus. The eye recovered in five days.

My own notes include twelve cases of ophthalmia neonatorum, where the colon bacillus—or at all events, a bacillus belonging to the colon group—was found alone, or together with the xerosis bacillus. In the 19 cases of ante-partum ophthalmia analysed on page 106 there was one instance of coliphthalmia—that is, 5·26 per cent. of the series.

The ophthalmia, invariably observed within the first four days of life, was bilateral, of moderate severity, and clinically resembled the commoner gonococcal infections. The corneæ were not affected. The cases all did well.

By grouping the figures given above we find that colon bacillus was present in 9·55 per cent. of the 157 cases of ophthalmia reported by Groenouw and by Alt. Among my own cases of ophthalmia, 171 in number, it occurred in 12, or 7·01 per cent. It may be concluded, therefore, that next to the gonocoecus and to the pneumococcus, the colon bacillus is the commonest cause (8·25 per cent.) of ophthalmia neonatorum.

3. *Koch-Weeks' bacillus*.—This tiny bacillus, which is the commonest cause of acute infective ophthalmia, or “blight,” in London, was first discovered by Koch (*Wien. med. Woch.*, December 29, 1883), who during a visit to Egypt in 1883 examined bacterioscopically some 50 cases of the ophthalmia of that country. He found two microbes in the eye-discharges—the one associated with severe, and the other with mild, symptoms of disease. The former appeared to be identical with Neisser's gonocoecus, while the latter he described as a very small bacillus. Haensell in 1886 spoke of having found an organism in catarrhal ophthalmia. In the same year John E. Weeks, of New York, published a careful memoir upon the subject (*Archives of Ophthalmology*, 1886, p. 441). He discovered that small, well-defined bacilli were always present in the secretion of acute catarrhal ophthalmia, or “pink eye,” as the disease was called in America. Inoculation of the eyes of rabbits and guinea-pigs with the discharge gave negative results, but Weeks succeeded in setting up the disease when the specific muco-pus was implanted on the human conjunctiva.

He failed to obtain a pure culture of the organism, as he found a small, club-shaped bacillus (probably the xerosis bacillus) in all his cultures. In 1887 Kartulis (*Centralbl. f. Bak. u. Parasitenk.*, 1887) identified the same organism in cases of Egyptian ophthalmia, and out of six inoculations of the human eye set up the disease twice.

In the course of a discussion at the French Society of Ophthalmology, in May, 1901, upon affections of the conjunctiva from the bacteriological point of view, Panas stated, *à propos* of ophthalmia neonatorum, that sometimes the gonococcus might be found, and sometimes Weeks' bacillus (*Rev. générale d'ophthalmologie*, Tome X, 1891, p. 269). But Morax (*Thèse de Paris*, 1894, p. 56) appears to have been the first to identify definitely the organism in a case of infantile ophthalmia. His patient was aged twelve days, and was affected with an acute contagious conjunctivitis. Since that date, the Koch-Weeks' bacillus has been recognised in ophthalmia neonatorum by several observers—as, for example, Cuénod (*Gaz. des Hôpitaux*, 1894), Francisco (*New York Eye and Ear Infirmary Reports*, 1895), Chartres (*Thèse de Bordeaux*, 1896), Gonin (*Rev. méd. de la Suisse Romande*, 1899), Thomin (*Thèse de Paris*, 1901), Druais (*Thèse de Paris*, 1904), Pollock (*Trans. Ophthal. Society*, 1905), and Augé (*Thèse de Paris*, 1906.) Speaking from my personal experience, the cases of ophthalmia associated with the Koch-Weeks' bacillus in babies generally supervene after the fifth day, are of mild character, and are marked by muco-purulent rather than purulent discharge. Signs of anything approaching acute inflammation are generally conspicuous by their absence. In four of the cases that I have seen, among about fifteen, the infection appeared to have been transmitted to the baby from some other member of the household, suffering at the time from "blight."

4. *Morax-Axenfeld bacillus*.—This micro-organism was discovered by Morax (*Ann. de l'Institut Pasteur*, June, 1896) and, independently, by Axenfeld (*Ber. der Ophthal. Gesellschaft*, Heidelberg, 1896), in the year 1896. It is the cause of an extremely common affection of the conjunctiva, the leading features of which are chronicity, mildness, trivial secretion, and the lack of tendency to get well of itself in the absence of well-directed treatment. Its pathognomonic sign is a redness

and soreness of the delicate skin at the outer or inner angle of the eyelids, so-called "angular blepharitis," by which alone its existence can be recognised in a majority of the cases which seek medical advice. Although the course of diplobacillary conjunctivitis is nearly always chronic or sub-acute, yet acute cases may be seen occasionally, a point emphasised in a recent communication by W. B. Inglis Pollock (*Trans. Ophthal. Society*, Vol. XXV, 1905, p. 3). It is under the guise of this acute form that the disease has been described in newly-born babies. A. Collomb (*Rev. méd. de la Suisse Romande*, 1899, Dec. 20th) reported four mild cases in infants under one year, in all of whom the inflammation had commenced shortly after birth. E. Andrade (*Amer. Journ. of the Medical Sciences*, 1902, p. 284) found the bacillus in a case of medium severity met with in a baby. The disease had lasted nearly three months, and the organism was found late in the history of the case. Usher and Fraser (*Royal London Ophthalmic Hospital Reports*, Vol. XVI, Pt. IV), again, found the diplobacillus once in a series of 21 cases of ophthalmia neonatorum, all of which had been diagnosed clinically as due to the gonococcus. The authors comment upon the fact that Groenouw never once met with the organism in his 100 cases of ophthalmia neonatorum (*Archiv f. Ophthal.*, Bd. LII, 1901, p. 1). The figures given by Gonin and Haupt and Druais and Augé make no mention of these cases.

Speaking for myself, I have seldom seen the diplobacillus in the discharge from recent ophthalmia neonatorum, except occasionally in association with the gonococcus. I am familiar with the organism, however, in cases that (with or without treatment) have taken on a sub-acute or chronic type, and I have been in the habit, rightly or wrongly, of regarding the latter condition as one initiated and kept up by the presence of the microbe. Such cases, at all events, are more readily cured by the zinc salts, as the chloride, sulphate, or salicylate, which are now universally recognised as specifics in the ordinary form of diplobacillary conjunctivitis.

Before leaving the subject, it should be pointed out that the Morax-Axenfeld organism must be distinguished from a closely allied and possibly identical form, known as the bacillus liquefaciens of Petit (1898), also found in certain affections of

the eye, such as ulcers of the cornea, with or without pus in the anterior chamber. The differentiation can be established only by culture, since the Morax-Axenfeld organism will not grow upon ordinary agar-agar, whereas the other microbe will do so readily. The latter will also liquefy gelatine.

5. *Klebs-Löffler bacillus*.—That a membrane might often be found upon the conjunctiva of infants suffering from ophthalmia was a fact mentioned by Chassaignac many years ago (*Annales d'oculistique*, Tome XVIII, 1847, p. 138). von Graefe stated (*Arch. f. Ophthal.*, Bd. I.) that genuine diphtheria of the conjunctiva was never found in the newly-born, an assertion repeated by D. C. Lloyd-Owen in 1894 (*Birmingham Medical Review*, 1894, p. 278). Morel (de Fleurier), in 1869 stated that he had seen true diphtheritic ophthalmia in newly-born babies (ref. in *Amer. Journ. of Obstetrics*, Vol. 1, 1869, p. 91). Nettleship (*Medical Times and Gazette*, September 18th, 1875) reported a severe unilateral membranous ophthalmia in a male infant, noticed when the baby was ten days old; and Jonathan Hutchinson (*Ibidem*, March 31st, 1877), a couple of years later, mentioned a much milder case in a new-born infant. John Tweedy, again, in 1883 (*Lancet*, July 7th, 1883), mentioned three cases of inflammation in infants, 1 to 4 weeks old, "allied to genuine diphtheritic ophthalmia."

With the discovery of the specific organism by Klebs in 1875, and the demonstration of its pathogenicity by Löffler in 1884, however, the question of ocular diphtheria was placed on a more satisfactory basis. Scientific observers then refrained from terming "diphtheritic" any membranous conjunctivitis, and restricted the term to cases in which the specific bacillus could be actually demonstrated.

Despite the dictum of von Graefe, instances of true diphtheritic ophthalmia have been observed in newly-born children. P. Zweifel (*Arch. für Gynäk.*, Bd. XXIII, Heft 2, p. 325, 1884) mentioned a case of diphtheria in a baby on the seventh day of life, in which the diagnosis was confirmed microscopically. It was significant that another baby experimentally inoculated with the mother's lochia did not develop ophthalmia, and that the father of the first baby had himself suffered from diphtheria. Chartres (*Thèse de Bordeaux*, 1896) found the (?)

Klebs-Löffler bacillus in no less than 12 per cent. of the 26 cases of ophthalmia neonatorum investigated by him bacteriologically. Groenouw (*loco citato*) failed to meet with virulent diphtheria bacilli in the forty cases of ophthalmia investigated by him. Axenfeld (*Deutsch. med. Woch.*, No. 14, 1898), however, described such a case observed immediately after birth, in which one cornea was already infiltrated. Bacilli from Axenfeld's case killed a guinea-pig in twenty-four hours. Two somewhat doubtful cases have been described by Aubineau (*Thèse de Paris*, 1894-5) and by Lagrange (*Soc. de Méd. de Bordeaux*, March 8, 1895) in babies, aged 18 days and one month respectively. Of ten cases of infantile ophthalmia described by Norton L. Wilson in 1899 (*Philadelphia Medical Journal*, Feb. 11, 1899), two appear to have been instances of conjunctival diphtheria. A case was reported in 1901, in a baby, aged ten days, by J. F. Bullar (*Trans. Ophthal. Society*, Vol. XXI, p. 9), as to the diphtheritic nature of which there can be no two opinions, although bacteriological evidence is unfortunately lacking. The nurse who attended the confinement had said it was a "cold," and (to quote Bullar's expressive words) "with that she opened the child's eye and spat in it, and wiped it with a general purposes cloth used in the bedroom." A yellowish-white, readily separable membrane lined the lids, which were much swollen. The cornea was clear. Later, membrane appeared in the nose and fauces, the temperature rose to 100.4° F., and the baby died in convulsions thirteen days after the onset of the ophthalmia. It may be noted that during the baby's illness another child in the house developed a white patch in the throat and a temperature of 104° F. It is also suggestive that three or four months before, the children in the house had been affected with measles, followed by a chronic nasal discharge. Quierel (*Leçons de Clinique Obstétricale*, 1902, p. 199) twice met with diphtheroid forms of ophthalmia neonatorum. One of the babies died. Saemisch (*Handbuch der gesamten Augenheilkunde*, Bd. V, 1 Abteilung, 1904, p. 262) met with a case of diphtheritic ophthalmia, involving one eye alone, in a baby aged six days. Lastly, Brewerton (*Lancet*, April 11, 1903) found the Klebs-Löffler bacillus twice in a series of (?) 18 cases of purulent ophthalmia.

To judge from my own experience, the Klebs-Löffler bacillus must be extremely uncommon in the ophthalmia of babies, since, despite many bacteriological examinations of such cases, I have never yet found it. The closely allied xerosis bacillus, however, is common (whether the eyes be inflamed or not), and it is impossible to resist the suspicion that it may have been confounded, on occasion, with the true diphtheria bacillus.

I may say, in passing, that in 43 cases of diphtheria of the conjunctiva, published by me recently (*Trans. Ophthal. Society*, Vol. XXII. 1902, p. 59), there were ten patients under twelve months, while the youngest patient was six weeks of age.

Cases are on record of diphtheria of the vulva or vagina of puerperal women. Such have been described by Nisot (*Bull. de la Soc. belge de Gyn et d'Obst.*, 1896), by Bumm (*Zeit. f. Geb. u. Gyn.*, 1895), and by J. W. Williams (*American Journ. of Obstetrics*, 1898, Vol. XXXVIII, p. 180). A few cases have been recorded where the bacillus diphtheriae has been discovered in the uterine or vaginal lochia in puerperal fever. Thus, F. W. N. Haultain (*Lancet*, June 26, 1897, p. 1745) reported such a case, in which Klebs-Löffler bacillus was found in discharge from the cervical canal thirty days after confinement. H. W. Longyear (*American Journ. of Obstetrics*, Vol. XXXVI, 1897, p. 489) reported six cases in which the Klebs-Löffler bacillus, found in the genital tract and confirmed by culture, was the active factor in puerperal infection. Lastly, Foulerton and Bonney (*Trans. Obstet. Society of London*, Vol. XLVII, 1905, p. 11), under similar circumstances, have twice discovered a bacillus morphologically indistinguishable from *B. diphtheriae*, although otherwise it presented two points of difference, in that (1) it produced no acid in glucose pepton-broth after six days incubation at body temperature, and (2) it was non-pathogenic as regards the guinea-pig. Those authors hint that the organisms described by others as those of diphtheria might possibly have been the ones they now mention. It is possible that the diphtheroid bacilli, described by Foulerton and Bonney, are identical with the xerosis bacilli, familiar to every ophthalmic surgeon.

6. *Pneumobacillus*—Little has been written concerning Friedländer's bacillus in inflammations of the conjunctiva. W. A. Brailey and Eyre, however, described a few years ago

(*Lancet*, March 20, 1897) a case of pseudo-membranous conjunctivitis, in the discharge and membrane from which they found this organism. The patient was 60 years of age. George S. Derby (*American Journal of Ophthalmology*, January, 1905) found a virulent pneumobacillus in a case of mild conjunctivitis affecting one eye of a woman, aged 58 years. Groenouw (*loco citato*, p. 279) once found the microbe in association with gonococci in his series of 40 cases of infantile ophthalmia. Kreseritzki reported a case of ophthalmia neonatorum apparently caused by the organism, v. Ammon (*Münch. med. Woch.*, 1900, p. 12) discovered the pneumobacillus thrice in 100 cases of ophthalmia neonatorum.

7. *Influenza* and Pseudo-Influenza bacillus*.—Haupt (*Klin. Monatsbl. f. Augenheilkunde*, 1903, II, p. 447) came across the influenza bacillus twice in the series of 62 cases of ophthalmia neonatorum examined by him bacteriologically. Druais (*Thèse de Paris*, 1904, p. 85) found the same organism in a mild ophthalmia, dating from the second day of life. The inflammation was unilateral, associated with coryza, and recovered in fifteen days without any corneal lesion. Augé (*Thèse de Paris*, 1906, p. 33) found the Pfeiffer bacillus once in a series of 165 cases. Zur Nedden (*Klin. Monatsbl. f. Augenheilkunde*, XXXVIII, 1900, p. 173) described the so-called pseudo-influenza bacillus in a typical case of ophthalmia affecting both eyes of a child aged ten days; and Haupt (*loco citato*) found the same organism in a single case. So far as I am enabled to judge from the description given, these organisms appear to be identical with one another and also with the Koch-Weeks bacillus. However that may be, one thing, at all events, is certain, namely, that it would be impossible to differentiate between the three microbes—Koch-Weeks', influenza, and pseudo-influenza—by the mere examination of cover-glasses smeared with secretion from the inflamed eyes, and stained in the usual way. The distinction (assuming such to exist) could not be established without quite an elaborate bacteriological

*Jundell (*Mitteil. aus der Augenklinik des Carol. Med.-Chir. Inst. zu Stockholm*, 1902) saw nine cases of conjunctivitis in infants during an epidemic of influenza in the Stockholm Children's Hospital. Six were slight, two were of medium severity, and one resembled gono-ophthalmia. No corneal complications. Both eyes affected in each case. Jundell believed that the conjunctiva had become inoculated with infective secretion from the nose or throat of the patients. Zur Nedden (*Klin. Monatsbl. f. Augenheilkunde*, 1903, XLI, Bd. 1, p. 209) investigated 13 of these cases, 10 of which were children in the first two years of life.

investigation, such as lies altogether beyond the reach of the average ophthalmic surgeon.

8. *Common pyococci*.—Ten years ago I described, in the columns of the *Lancet* (November 13, 1897), a series of cases in children in whom a conjunctivitis coincided in point of time with a pustular eruption of the face or scalp or with otorrhœa, and I suggested, as the outcome of my bacteriological investigation of the cases that all the conditions named were due to pyococci. George Carpenter (*Archives of Pediatrics*, 1894, p. 452) had earlier described such cases from the purely clinical standpoint. As regards newly-born babies, I have met with the *staphylococcus albus* and *aureus* in association with the *gonococcus*, and in two instances I have found the *staphylococci* in pure and abundant culture. It may be noted that Groenouw found the *staphylococcus aureus* in pure culture four times only, and v. Ammon twice, each in a series of 100 cases of ophthalmia neonatorum.

Staphylococci are recognised as the causative factors in certain cases of non-specific urethritis (R. W. Taylor); and they have been found, without other microbial associations, in a few cases of puerperal sepsis (Hoff, A. K. Gordon).

9. *Streptococcus pyogenes*.—It is rather surprising that streptococci should not be commoner in the ophthalmia of babies, seeing that the organism is a tolerably frequent inhabitant of the female genital tract (Menge and Krönig) and is, besides, known to be the predominating factor in the causation of puerperal fever* (Pasteur and Dolériss). G. B. Miller (*Amer. Journ. of Obstet.*, Vol. XXXIX, 1899, p. 780) found streptococci seven times (5·5 per cent.) among 127 inflammatory conditions of the female organs, as pelvic abscess and exudation, pelvic peritonitis, sactosalpinx, ovarian abscess, suppurating cysts, and infected myomata. Nearly the same percentage (6 per cent.) was present in 620 cases collected by Miller from the literature dealing with pyosalpinx and acute salpingitis. In a series of 150 cases of puerperal infection, in which the uterine

*It appears, however, that the streptococci found in the vaginal secretions have in many instances lost their pathogenicity. This is shown by the researches of Döderlein (*Das Scheidensekret u. seine Bedeutung für das Puerperalfebril*, Leipzig, 1892), who found streptococci eight times among 195 cases examined, but the organisms were virulent in five instances only. Walthard (*Deutsch. med. Wochenschr.*, October 24, 1894), again, who discovered streptococci in 27 of 100 women, found by experiments on animals that the pathogenicity of the organism was latent.

lochia were examined bacteriologically, J. Whitridge Williams (*Obstetrics*, 1906, p. 762) found streptococci 31 times pure, and 13 times mixed with other micro-organisms. In 49 cases of puerperal septicaemia A. K. Gordon (*Lancet*, March, 30, 1907) found streptococci in 29.

The streptococcus, moreover, is known to account for some cases of non-specific urethritis in man.

As regards its occurrence in ophthalmia neonatorum, Chartres (*loco citato*, p. 39) found it alone or associated with other microbes in no less than 28 per cent. of his cases; Thomin (*loco citato*, p. 32) in 20 per cent.; and Pollock (*loco citato*, p. 32) associated with the gonococcus, in a single case of ophthalmia neonatorum, complicated with an ulcer of the cornea. Cramer (*Arch. f. Gynäk.*, LIX, i, 1899, p. 184) observed a case of secondary ophthalmia in the baby of a woman whose temperature was raised owing to retention of lochia, in which the same organism was demonstrated. Darier (*La Clin. Ophtal.*, March 10, 1903) reported a case observed on the ninth day of life. In Groenouw's second series, dealing with 100 cases of ophthalmia neonatorum (Graefe's *Arch. f. Ophthal.*, 1901, p. 73), streptococci were found in three cases—twice alone and once along with gonococci. Augé (*Thèse de Paris*, 1906) met with the organism thrice in a series of 165 cases. A. Lawson (*Medical Press and Circular*, February 6, 1907, p. 149) has described a severe case, with membrane upon the conjunctiva, and destruction of both corneæ, in a baby sixteen days after birth. Swabs taken from the conjunctiva showed almost pure cultures of the streptococcus pyogenes. The streptococcus, however, did not figure on Gonin's list, nor in Groenouw's first series of cases, and was found once only (in culture) in Haupt's careful investigations.

10. *Streptobacillus*.—Druais (*Thèse de Paris*, 1904, p. 89) has reported a case of bilateral ophthalmia in an infant of fifteen days, possessing at the first all the characters of a gonococcal inflammation, but found bacteriologically to be associated with a streptobacillus, staining by Gram, forming chains of 20-30 elements, and growing on ascites-agar. On further culture, however, the organism showed a tendency to take on the streptococcal form. The ophthalmia was cured after five days' treatment.

11. *Micrococcus luteus*.—In a remarkable case which presented the clinical picture of severe bilateral blennorrhœa,

Groenouw (Graefe's *Arch. f. Ophthal.*, 1901, p. 45) failed to find the gonococcus either in cover-glass preparations or in cultures upon suitable media, but instead he discovered a white coccus (moderately pathogenic for the cornea of the rabbit) which resembled the micrococcus luteus of Lehmann and Neumann, without perhaps being identical with that micro-organism. Groenouw's observation, so far as I know, has been as yet confirmed by no other author.

12. *Bacillus pyocyaneus*.—v. Herff (ref. in Axenfeld's *Die Bakteriologie in der Augenheilkunde*, 1907, p. 211) found the bacillus pyocyaneus twice in cases of ophthalmia neonatorum. George S. Derby (*American Journal of Ophthalmology*, January, 1905), found in smears and on blood-serum an organism typical of the pyocyaneus group associated with *staphylococcus pyogenes aureus* and *xerosis bacillus*. No test as regards the virulence of the microbe was made. The sequel of the case was not reported. A reference to No. 19 on the list given on page 109 will give details of a case of ante-partum ophthalmia observed by me, in which many of these organisms were found in the pus from the baby's eye, together with the *xerosis bacillus*. The case was not specially severe and ended favourably.

It will be remembered that the bacillus pyocyaneus was found by Foulerton and Bonney (see p. 51) in certain puerperal infections.

The facts brought forward in the foregoing pages may be summed up by saying that although ophthalmia neonatorum may be due to microbes other than the gonococcus, yet that organism accounts for about two-thirds of all cases, and for almost every complicated instance of the ailment. Some of the organisms found in ophthalmia, particularly the colon bacillus, the streptococcus, and the pneumococcus, are known to occur in the genital passages of pregnant and puerperal women, and the same organisms have been met with in the male urethra.

It will be apparent, therefore, that a first necessity in the exact diagnosis of ophthalmia neonatorum is a bacterioscopic examination of the secretion from the inflamed conjunctiva. After some clinical experience, it is true, there is not much difficulty in identifying most cases of true gonorrhœal ophthalmia, but the diagnosis can never be said to rest upon a sound and

scientific basis unless gonococci have been actually identified. There exist, indeed, so-called "catarrhal" cases where the signs are so slight that no observer, no matter how experienced, would suspect that gonococci lay at the root of the mischief, and no amount of mere clinical acumen will enable one to identify such cases with even a tolerable approach to certainty.

One such case may be briefly quoted from my own records :

Case No. 4.—William B———, aged 10 days, was brought on February 26, 1902, with an inflammation of the right eye. He was the first child, and born at term after a normal labour. His eye became inflamed on the seventh day, so that one clearly had to deal with an instance of "secondary" infection. There was a little yellowish-white discharge from the inflamed eye ; the lids were neither swollen nor reddened ; the eye could be readily opened by the infant ; the cornea was clear ; the tear-passages were seemingly normal. A note was made on the out-patient letter at the time to the effect that the condition did not resemble the gonococcal form of ophthalmia. Yet by means of cover-glass preparations, grouped gonococci not staining by Gram, were found to be tolerably numerous in discharge from the eye. An agar tube inoculated with secretion and placed in the incubator, remained sterile.

There is, indeed, abundant evidence to show that although nearly all severe cases of ophthalmia neonatorum are associated with the gonococcus, yet the organism in question need not necessarily give rise to a grave form of disease so far as the clinical appearances are concerned. For example, J. E. Weeks (*Medical Record*, July 24, 1886) in six cases where gonococci were present, had two only of a severe description. Indeed, as J. A. Andrews (*New York Medical Journal*, June 21, 1890) has well expressed it : "In some rare instances, the presence or absence of the gonococcus, and not the clinical picture, must decide the diagnosis."

The difficulty of diagnosis is not lessened by the existence of so-called "abortive" cases of gonorrhœal ophthalmia, of which a good instance has been reported by E. Ammann (*Klin. Monatsbl. f. Augenheilkunde*, XXXV, 1897, p. 307). In that case the infant, when seen on the fifth day after birth, manifested a trivial conjunctivitis, the symptoms of which were stated to have been present when the baby was born. It was associated with gonococci. The usual treatment was prescribed, and on the following day secretion had much diminished, and it disappeared along with the other signs of inflammation, in a very short time.

The practical importance of these "catarrhal" and "abortive" cases lies in the fact that despite the apparent mildness of their clinical symptoms, they may at almost any moment be complicated with corneal mischief, as in cases observed by

Groenouw (v. Graefe's *Arch. f. Ophthal.*, Bd. LII, 1, 1901) and by Druais (*Thèse de Paris*, 1904, p. 51). In the case to be next related the same kind of thing was noticed :

Case No. 5.—A well-nourished child, aged 9 days, had developed ophthalmia in his right eye on the third and in his left on the fifth day after birth. The symptoms were mild, so that he could open his eyes fairly well. Swelling of the lids was practically absent, but the secretion, muco-purulent in appearance and scanty in amount, contained gonococci in fair numbers. The right cornea showed an oval infiltrated ulcer in its lower third. The baby had been born at term, after a normal labour lasting about fourteen hours. The case had been attended by a midwife. The symptoms soon yielded to treatment, and some six months after the child was first seen, it was difficult to assure oneself that the right cornea was not perfectly transparent.

On the other hand, as must be apparent from what has gone before, what clinically looks like a case of gonorrhœal ophthalmia sometimes proves on bacteriological examination to be associated not with Neisser's coccus, but with some other micro-organism. The existence of such cases is recognised by everybody who has devoted attention to the subject. Groenouw's first investigation (*Bericht der Ophthal. Gesellschaft*, Heidelberg, 1899) brought out the point clearly. Thus, in four cases of slight ophthalmia he found gonococci once, bacterium coli once, and an unidentified organism once. In 13 medium and severe cases, on the contrary, he found gonococci in twelve, and in one a variety of micrococcus luteus. In other words, gonococci were present in 50 per cent. of the mild and in 92 per cent. of the medium and severe cases of ophthalmia neonatorum. Groenouw's later figures (v. Graefe's *Arch. f. Ophthal.*, LII, 1, 1901, p. 61) tell the same tale, although perhaps in not so striking a way. Among 42 mild cases, so-called "catarrh," gonococci were present in two—or 4·75 per cent., whereas among 57 more severe cases, so-called "blennorrhœa," they were found in 39—or 68·43 per cent.

It may be concluded, therefore, that gonorrhœal ophthalmia cannot be diagnosed with certainty in the absence of a bacteriological examination of the discharge from the eyes, a point in which it resembles gonorrhœa itself.

In my experience, the bacterioscopic diagnosis of gonococci offers no especial difficulties as regards secretion from the conjunctiva, whatever it may do in that from certain other parts of the body. I can scarcely help thinking that there has been, and is still, a little tendency to exaggeration, in some

quarters, as to the differential diagnosis of these organisms. *The intra-cellular groups of numerous biscuit-shaped diplococci, which are readily decolourised by Gram, but which retain the basic aniline dyes with some tenacity, are very characteristic.* The double staining with pyronin and methyl green, or with auramine II and thionin, although, of course, not specific as regards the gonococcus, yields excellent results. Another stain well adapted for the morphological identification of the gonococcus is the mixture of carbol-fuchsine and methylene-blue that bears the names of Pick and Jacobsohn (1896).

The discovery in cases of pronounced infantile purulent ophthalmia of grouped intracellular diplococci, not staining by Gram, is for all practical purposes conclusive of the presence of gonococci. There can be no such certainty, however, in cases of mild conjunctivitis in babies, even when bacteria of similar appearance and arrangement are found in cover-glass preparations of the discharge. It is, I believe, especially in these latter cases that further investigations are required before the existence of gonococci can be safely affirmed.

Indeed, cultures might be superfluous were it not for the fact that C. Fränkel (*Zeitschrift f. Hygiene u. Infektionskrankheiten*, Bd. XXXI, 1899, Heft 2, p. 221) reported not long ago three cases of pseudo-membranous conjunctivitis in children associated with the meningococcus. P. Haglund, again (*Klin. Monatsbl. f. Augenheilk.*, 1900, *Beilageheft*, p. 72), has described a case of severe unilateral purulent ophthalmia, complicated with corneal mischief, in a boy of five months, in the pus from whose eyes he discovered intra-cellular diplococci, which by means of cultures were shown to be the diplococcus intra-cellularis meningitidis of Weichselbaum and Jäger. Cases of conjunctivitis, although not in babies, associated with the meningococcus, have been reported by Koplik (1904), Dorland Smith (1905), Gabriélidès (1906), E. S. Thomson (1906), and G. C. Robinson (1906). Moreover, it is possible, although the author denies the fact, that the same micro-organism was observed by F. Krukenberg (*Klin. Monatsbl. f. Augenheilk.*, XXXVII, 1899, p. 271) in a case of mild chronic conjunctivitis occurring in an adult patient. Krukenberg

called his organism the "pseudo-gonococcus." It was met with in intra-cellular groups, as well as free in the discharge, and was decolourised by Gram's method. The cocci were grouped in twos, threes, and tetrads. The organism did not grow on glycerine-agar, but flourished on blood-serum, a contrast to the gonococcus. A further point of difference from the Neisser coccus lay in the fact that the Krukenberg organism was found to be able to bear a high temperature without losing its powers of reproduction. It had a virulent effect when a bouillon suspension was injected into the peritoneal cavity of guinea-pigs and white mice, but was non-pathogenic as regards the conjunctiva and cornea of the rabbit. Introduced into Krukenberg's own eye, neither old nor young cultures produced the least inflammatory reaction, and on the day following the inoculation the conjunctival sac was found to be sterile.

Theodor Axenfeld (*Die Bakteriologie in der Augenheilkunde*, Jena, 1907, p. 199 *et seq.*) has recently called attention to the possible confusion that might exist between the gonococcus, on the one hand, and the micrococcus catarrhalis (Kirchner), on the other. The latter organism, an aërope, is found in normal and catarrhal conditions of the nose and pharynx, as well as in bronchitis. Its pathogenicity as regards the conjunctiva is still in dispute, although it has been demonstrated in cases of slight chronic conjunctivitis by Brons in Axenfeld's klinik (*loco citato*, p. 206 *et seq.*, and *Klin. Monatsbl. f. Augenheilkunde*, January, 1907). The micrococcus catarrhalis, like the gonococcus, is Gram-negative, and may be grouped within the protoplasm of the pus-cells, although that feature is not so marked as in the case of the Neisser coccus. It is often somewhat larger than the gonococcus. It grows freely on all media at 20° C., and liquefies neither gelatine nor serum. It does not coagulate milk. No indol formation. Tetrads are abundant in cultures. It is more resistant than the gonococcus.*

In this connection it should be mentioned that Foulerton and Bonney (*Trans. Obstetrical Society of London*, Vol. XLVII,

* According to J. A. Arkwright (*Journal of Hygiene*, January, 1907), the micrococcus catarrhalis is present very frequently in the normal nose, more especially in infants. It agglutinates spontaneously; and does not produce acid from any of the carbohydrates, as glucose, maltose, saccharose, galactose, on which it has been tried.

1905) in the course of an investigation into the pathogeny of puerperal fever, found in the uterus upon two occasions an organism that presented a close resemblance to the gonococcus. They discovered a precisely similar organism in the cervical secretion of non-pregnant women and once also in the vaginal lochia when the puerperium was normal and the uterus sterile. The diplococcus in question did not stain by Gram, but grew on all the ordinary media, including gelatine. If this microbe occurs in the maternal passages, even although rarely, it cannot logically be denied that it may some day be found in the conjunctival sac of the infant. Its possible existence in the eye furnishes an additional reason, if one be needed, for the making of cultures in the exact diagnosis of the gonococcus.

In order to differentiate between the five organisms—the gonococcus, the meningococcus, the "pseudo-gonococcus," the micrococcus catarrhalis, and the Foulerton-Bonney diplococcus—it appears we must inoculate agar slants, and incubate the tubes. The gonococcus, of course, will not grow on that medium, *unless an unusual amount of blood or of pus has been taken from the eye* and never at the room temperature. On the other hand, the meningococcus, the micrococcus, catarrhalis, and the Foulerton-Bonney diplococcus will flourish. The pseudo-gonoccus will grow freely on animal blood serum, while the growth of the gonococcus is likely to be scanty on that medium. It may be added that the Foulerton-Bonney diplococcus does not liquefy gelatine.

It is important to bear in mind that the diplococcus meningitidis has not yet been found in the ophthalmia of babies, and that a similar remark applies equally to the pseudo-gonococcus and to the micrococcus catarrhalis. The Foulerton-Bonney organism has not yet been identified in the conjunctival sac at any time of life.

It must never be concluded from a single negative examination of pus from the eye that gonococci are absent. Before that can safely be affirmed, it is necessary to make at least two investigations on separate occasions. The reasons for this somewhat elementary precaution are self-evident: (*a*) owing to faulty methods or to involution changes, organisms, although present, may not be stained; (*b*) a few scattered microbes may readily be overlooked in searching through a

microscopical specimen ; and (c) gonococci may be overlain, as it were, by other organisms, especially the xerosis bacillus. The Gram method must *invariably* be employed, in addition to staining with methylene blue or other basic aniline colour.

If specimens be taken in the ordinary way—*i.e.*, by simply separating the eyelids and taking a droplet of pus from between them—one will find in, roughly, one-third of the cases, as tested by the Gram method, staphylococci and xerosis bacilli. Personally, I nowadays proceed in a slightly different manner. The pus is first washed away from the inflamed eye by means of a stream of tepid saline solution, and the baby is put on one side until discharge has again accumulated. From the latter I smear my cover-glasses, and, if necessary, streak my culture tubes. By adopting this plan I often succeed, in recent cases, in obtaining the gonococcus in pure culture, as far as smear preparations are concerned. In cultures, however, few or many colonies of the xerosis bacillus are generally present.

One or two points with regard to the gonococcus as it occurs in ophthalmia neonatorum may be briefly mentioned as possessing some little practical importance: 1st. The earlier the stage of the disease, the less tendency is there for the characteristic grouping within the cytoplasm of the pus or epithelial cells. In other words, the gonococci have a greater tendency to be free than in the older cases. In early cases, too, an unusual number of epithelial cells are generally found in the specimen. 2nd. The number of organisms present in a given case has seemed to me to bear a direct relationship to the intensity of the disease-process. 3rd. The gonococci may persist for long after the acute symptoms of ophthalmia have subsided.

With reference to the second point, Groenouw (*loco citato*, p. 27) appears to hold the contrary view, namely, that the number of gonococci bear no relationship to the severity of a given case. The following table, taken from page 27 of his monograph, does not, however, seem to bear out his assertion. Indeed, to my mind, it proves just the contrary, allowance being made for the relatively small numbers (39) analysed :—

Clinical type of disease.	Gonococci found in cover-glass preparation in per cent. of the cases.			Total of cases.
	Scanty.	Moderate.	Numerous.	
Conjunctival Catarrh	100 per cent.	—	—	2
Blennorrhœa—mild	20 „	60 per cent.	20 per cent.	10
Blennorrhœa—medium	33·3 „	33·3 „	33·3 „	3
Blennorrhœa—severe	8·3 „	54·2 „	37·5 „	24

The following are cases in illustration of the last point :

Case No. 6.—Violet C——, ætat. 9 weeks, was brought to me on November 10th, 1897, suffering from bilateral ophthalmia, stated to have commenced on the third day after birth. With the microscope, discharge from the eyes was found to include numerous gonococci, for the most part intra-cellular.

The next case is even more striking, inasmuch as the baby had been under active treatment for some time :

Case No. 7.—Alice M. C——, 3 weeks, first attended on March 21st, 1900. Baby born at term on February 23rd, after a natural labour lasting 14½ hours. Eyes were noticed to discharge as soon as the baby was born. A little lotion had been given by the medical man who attended the confinement. Gonococci present in the discharge from the eyes. The corneaæ were diffusely opaque, with several denser grey spots, but not actually ulcerated, and each was encircled by a vascular ring. The child was placed under active treatment, and a 2 per cent. solution of silver nitrate was applied to the eyes once a day at the Hospital. *April 11th* (47th day of disease), gonococci still present in numbers. *April 24th* (60th day of disease), gonococci can still be identified, although the eyes are now free from any obvious signs of inflammation, and the baby can open them well. *May 1st*, the discharge, now scanty and difficult to obtain, contains no organisms that can be recognized as gonococci. A small speck lies just below the centre of each cornea, which otherwise is clear.

My own results, it will thus be seen, are very different from those reported by Hubscher (*Arch. d'ophtalmologie*, July-August, 1885, p. 306), who found in a number of cases of ophthalmia neonatorum, that treatment speedily modified both the appearance and distribution of the gonococcus, and soon caused its complete disappearance. On the day following the commencement of treatment, according to this writer, there was a considerable diminution in the number of the micro-organisms, of which the intra-cellular grouping was more or less lost. Hubscher laid it down as an axiom that "the diminution of the micrococci constantly coincided with the cure of the malady" (p. 310).

It should be mentioned before leaving this aspect of the

gonococci, that the disappearance of those organisms need not necessarily coincide in point of time with that of purulent secretion from the conjunctiva, a fact in which ophthalmia neonatorum agrees with specific urethritis. This is well brought out by certain figures given by Groenouw (*Archiv für Ophthalmologie*, Bd. LII, 1901, p. 29). That observer analysed 15 cases from this point of view, and found that in 7 the micro-organisms disappeared 2 to 7 days before the secretion, while in 8 cases they persisted 1 to 25 days beyond the latter.

It is perhaps as well that the gonococcus can usually be diagnosed by the mere examination of smear preparations stained as I have described (p. 65). Despite the work of Bumm, Wertheim, and others, the cultivation of gonococci outside the human body has not, until recent years, been an altogether easy matter, even if one was provided with all the means necessary for the purpose, which an ophthalmic surgeon in his private capacity was scarcely likely to be. However, I have obtained good cultures by freely inoculating agar-agar slants, previously smeared with human blood. The medium is then kept at incubation temperature (37.5° C.). The colonies attain no great size, and speedily appear to lose their powers of reproduction, so that I have seldom been able to get sub-cultures after the lapse of a few days. Growths may sometimes be observed within twenty-four hours, as small, dew-like spots on the surface of the nutrient medium. Their microscopical appearance offers nothing worthy of remark, unless it be the fact that "giant" forms—that is to say, swollen cocci—are common after two or three days. These, like the familiar "clubs" of diphtheria bacilli, probably indicate impending dissolution of the micro-organisms. On certain specimens of perfectly fresh agar-agar one may now and then obtain a growth of the gonococcus, even when care is taken not to carry much pus over from the eye into the tube.

By growing the gonococci on a mixture of serum and agar it is claimed that they retain their properties rather longer, and this observation, which we owe to Kanthack and Stephens (*Lancet*, March 26, 1896), I am in a position to confirm personally. The best medium, however, is probably agar mixed

with ovarian, ascitic, or hydrocele fluid. Working with ovarian-agar, Usher and Fraser (*Royal London Ophthalmic Hospital Reports*, Vol. XVI, Part IV) invariably obtained cultures from twenty-four cases in which a film showed the presence of the Neisser coccus.

The ophthalmia produced by organisms other than the gonococcus, generally speaking, agrees in the several points that it is milder, has a shorter duration, and responds more readily and rapidly to remedies. Except when due to Klebs-Löffler bacillus or to streptococcus (which is seldom the case), it rarely affects the cornea, and in that fact lies the great practical importance of examining all cases bacteriologically. As to the last point, Kröner (*Bresl. ärztl. Zeitschr.*, Nos. 20 and 21, 1884) had corneal mischief in 25·3 per cent. of his 63 cases of gonococcal ophthalmia, and in none of his 29 non-gonococcal cases. v. Ammon (*Münch. med. Wochenschrift*, Vol. XLVII, January 2, 1900) observed keratitis in 14·28 per cent. of his 56 gonococcal cases, and in 4·54 per cent. of his non-gonococcal cases. Groenouw (v. Graefe's *Archiv f. Ophthal.*, Bd. LII, 1901, p. 30) noted ulcers of the cornea in 24·39 per cent. of his 41 gonococcal cases, and in no single instance among his 59 non-gonococcal cases. Haupt (*loco citato*, p. 467) found corneal damage in 28·8 per cent. of his 45 gonococcal cases, and in 11·76 per cent. of his 17 other cases. Druais (*Thèse de Paris*, 1904) noted corneal lesions in 6 of his 24 gonococcal cases—that is, in 25 per cent. Among his 39 non-gonococcal cases, on the other hand, he found only 1·8 per cent. of corneal damage. Turning to my own figures, of 38 gonorrhœal cases exactly 50 per cent. showed corneal lesions, while of 39 non-gonorrhœal cases the cornea was involved in 17·94 per cent. Some of the latter did not fall under treatment until late in the course of the disease, and gonococci could not then be demonstrated in film preparations, although it is likely that some of them were in reality due to the Neisser diplococcus, for on no other assumption am I able to account for so large a proportion, as compared with the figures given by other observers, with corneal mischief.

The figures adduced above are for convenience sake embodied in the following table :

A Table to show the percentage of Corneal damage found in gonococcal and non-gonococcal Ophthalmia respectively.

Name	Total Ophthalmia.	Percentage of corneal damage in	
		Gonococcal cases.	Non-gonococcal cases.
1. Kröner	92	25.39	—
2. v. Ammon	100	14.28	4.54
3. Groenouw	100	24.39	—
4. Haupt	62	28.80	11.76
5. Druais	63	25.00	1.80
6. Stephenson	77	50.00	17.94
Totals :—	494	27.976	6.006

Almost everybody who has devoted attention to the bacteriology of ophthalmia neonatorum has failed to find pathogenic micro-organisms in a certain proportion of the cases. A. Alt (*American Journal of Ophthalmology*, April, 1901) had three negative (or practically negative) results in 17 cases of ophthalmia, or in 17.64 per cent. Groenouw placed the figure at about one-third, and Haupt at 17.74 per cent. The highest figure was reached by Augé (*Thèse de Paris*, 1906), who had among 165 cases of ophthalmia neonatorum 77 negative bacteriological results, or no less than 46.6 per cent. Such amicrobic forms, it is important to note, need not necessarily run a mild clinical course. Cramer (*Arch. f. Gynäk.*, 1899, II, p. 59) has surmised that they may be due to injuries sustained by the conjunctiva while the baby is still *in utero*. Many of them, I am convinced, are premonitory or concomitant signs of congenital syphilis as in the cases related below :

Case No. 8.—Elizabeth S ——, aged 17 days, was seen June 11, 1901, at the Children's Hospital, Hackney Road, London. The mother (who had suffered from interstitial keratitis as a child) informed me that the baby's eyes got bad seven days after birth, and had discharged "yellow matter" ever since. The baby was wasted and snuffled vigorously. There were ulcerations around the anus and mouth. Bacteriological examination of discharge from the eyes, by means of cover-glass preparations and cultures, showed nothing beyond the xerosis bacillus and the staphylococcus pyogenes albus. The case, at no time a severe one, made a speedy recovery under the administration of small doses of mercury with chalk.

Case No. 9.—Eleanor E ——, aged 32 days, attended February 26, 1902, on account of a mild ophthalmia, the symptoms of which had made their appearance seven days after birth. Cover glass preparations smeared with discharge from the conjunctiva were found to contain bacilli, having the appearance and staining reactions of the xerosis bacillus. Cultivations do not appear to have been made. The baby was not thriving, although on the breast, and suffered from pronounced "snuffles."

Case No. 10.—Isidore B ——, aged 16 days, attended July 23, 1902. There was slight ophthalmia of the left eye, dating from the fourth day after birth. The

cornea was clear. The ocular discharge contained staphylococci only. Weight, 4½ lbs. "Snuffles." Right arm helpless, due to epiphysitis. Two children had been born dead. Later, the other eye became affected, but eventually both made a good recovery.

Case No. 11.—Alfred G ——, 19 days, seen in August, 1906, suffering from a bilateral blennorrhœa, of medium grade, stated to have commenced on the fifth day. Cornea clear. Neither by cover-glass preparations nor by the inoculation of agar tubes, some of which were smeared with blood, could any bacteria be identified, except a few colonies of xerosis bacilli. The baby was not thriving, had a shock of dark hair—the so-called "syphilitic wig," "snuffed," and his palms and soles showed that indescribable shiny, polished appearance sometimes seen in specific infants. Twenty-one days after his first attendance, he was found, on examination, to be out in a more or less generalised syphilitic eruption.

Cases such as those narrated above are analogous to the mild conjunctivitis that, in my experience, is not uncommon in association with the coryza and skin eruptions of congenital syphilis as seen in somewhat older babies. This, again, corresponds almost point by point with the conjunctivitis observed during the secondary stage of acquired syphilis, as in the following case :

Case No. 12.—Louisa H ——, 27 years, seen September 20, 1906, at the Kensington General Hospital, on account of her eyes, of which the right has been inflamed for four and the left for two days. Both eyes are considerably blood-shot, with manifest muco-purulent discharge. Palpebral conjunctiva reddened, but without definite eruption. The patient's voice is hoarse. Fauces show no lesions. Her face and the back of her hands are covered with a specific papular rash. The eyes soon recovered.

To assert that the failure to find micro-organisms in ophthalmia neonatorum is proof of their non-existence would be to commit a logical fallacy of no mean magnitude. The mere examination of smear preparations is not enough : cultures must be made in addition before that can be affirmed. It is possible that in some of the cases of ophthalmia described as amicrobic, a more careful or skilful investigation would have given positive results. It must not be forgotten that Wertheim (*Arch. f. Gynäk.*, Bd. XLII, 1892, Heft I, p. 1) has pointed to the existence of degenerated forms of gonococci, which, although they no longer stain properly, yet retain their pathogenicity. They take the form, so it is said, of granular spheres, which do not stain with watery solutions of the basic aniline colours. The same author on an earlier occasion (*Wiener klin. Wochenschr.*, 1890, No. 25) found, side by side with gonococci, in sections from cases of gonorrhœal salpingitis, bodies of irregular shape, which stained imperfectly, and yet bore so close a likeness to gonococci that they could only be looked upon as those organisms undergoing retrograde changes. Wertheim's

observations are obviously of importance from our present standpoint.

Moreover, in few of the so-called amicrobic cases has any attention been devoted to the possibility of anaërobic organisms being present in discharge from the conjunctiva. The widely recognised fact that most of the pathogenic organisms are aërobic, should not exclude a systematic search for possible anaërobic pathogenic germs. That, at all events, appears to be a point that will repay more careful attention in future researches into the bacteriology of ophthalmia neonatorum.

Finally, it may be stated in round numbers that of every 100 cases of ophthalmia neonatorum, 65 per cent. will be associated with gonococci, 10 per cent. with pneumococci, 5 per cent. with bacillus coli, 5 per cent. with other pathogenic organisms, as the Koch-Weeks bacillus, and 15 per cent will show negative bacteriological findings. Of the last-named no inconsiderable number, in my experience, are due to congenital syphilis.

2. The Mechanism of Infection.

Now the actual infection of the baby's eyes with gonococci, or with other micro-organisms, may come about :—

1. In the maternal passages before the act of birth ("primitive");
2. In the maternal passages during the act of birth ("primary");
3. Almost immediately after birth ("secondary A");
4. One or several days after birth ("secondary B").

The evidence at disposal points to the third, "secondary A," as the commonest mode of infection. A child, as is well known, normally traverses the vagina with closed eye-lids, and as the junction between the lids is watertight, and is, besides, sealed, so to speak, with the vernix caseosa, morbid secretions can scarcely enter the conjunctival sac under ordinary circumstances (Keilmann). That could nevertheless come about during face presentations, the application of forceps, or during digital explorations on the part of the accoucheur. In this mode of infection the germ-laden discharge from the maternal passages clings about the eyelids and eyelashes, and, as a rule, is carried

into the conjunctival sac after the head is born, either by the blinking of the baby, by the infant's fingers, or by the water, sponges, or towels used for the first bath. This mode of infection is spoken of as "Secondary A."

The evidence in favour of the view just stated is briefly as follows:—First, there is the fact already mentioned, namely, that the baby's eyelids are usually closed during its passage into the world. Secondly, it has been shown by the bacteriological studies of A. W. Sikes and myself (*Trans. Obstetrical Society of London*, Vol. XLV, 1903) that the eyes of newly-born babies, immediately after the cord has been cut and before they have been touched in any way, are sterile in 75 per cent. of the cases. Of 20 babies thus examined, we found the culture tubes sterile in 15, while in the remaining five tubes *sarcina aurantiaca*, *flava*, and *alba*, and a yeast-like *oidium albicans* were grown. In no single instance was a pathogenic organism demonstrated. Koblanck's investigations (*Festschrift für Karl Ruge*, Berlin, 1898) on 20 newly-born children agree with these results, since no germs were found (ref. in *Archiv. f. Gynäk.*, Bd. LIX, 1899, Heft I, p. 183). Cramer's investigations also confirm the fact that at birth the conjunctival sac is normally sterile. Thirdly, certain facts with regard to prevention, mentioned by Schirmer, by Porter, by Hague, by Korn, and by Snell respectively, tell in the same direction.

Hague, of Camberwell (*British Medical Journal*, June 21, 1879, p. 959), adopted the simple means of wiping away every trace of moisture from the eyes the moment the head was born, and never knew ophthalmia to occur when that had been done.

In 1882 G. Schirmer (*Centralbl. f. Gynäk.*, 1882, p. 209) advocated cleaning the face of the baby with a dry towel as soon as the head was born, and after the cord had been cut the entire body was wiped with another towel. A bath was given for the first time on the day following birth. Schirmer believed that infection was closely connected with the first bath, the water of which he characterised as "*Giftwasser*" (poison water). By this method of treatment Schirmer had no ophthalmia in 50 births. Results, however, fell off when the carrying out of the plan was confided to attendants. A couple of years later W. E. Porter (*Medical Times and Gazette*, June 28, 1884, p.

883) suggested the addition of the following rule to those laid down by the Ophthalmological Society for the prevention of ophthalmia neonatorum : " Directly a child is born to wipe its eyes with a soft cloth, particularly in each inner canthus or corner, using in the act of wiping gentle pressure rather than friction."

Korn (*Arch. f. Gynäk.*, XXXI, 2 1887, p. 240) in order to prevent ophthalmia, irrigated the vagina with sublimate and as soon as the head was born, cleansed the eyelids and surrounding parts by cotton soaked in plain water, fresh pieces being used until the parts were perfectly clean. Until the process was completed, every effort was made to prevent the baby from opening his eyes. After complete birth, but before the cord was severed, the face and head of the infant were washed in the way described. The baby's hands were kept from his eyes until such time as they had been well washed. In a series of 100 cases treated by this plan no single case of ophthalmia occurred. Encouraged by these results, Korn then gave up prophylactic douchings of the mother's vagina, and employed the other plan alone. Among 1,000 babies treated in this way there were three cases of ophthalmia, or 0.3 per cent. Korn made the striking statement that the babies even of mothers who suffered from granular vaginitis or other evidences of gonorrhœal infection remained free from ophthalmia. Snell's experiences (*Lancet*, September 1, 1888) were very similar. He also adopted the simple expedient of wiping away secretions with a morsel of lint moistened with water as soon as the head was born. During three years, 2,242 labours took place in the Jessop Hospital for Women, Sheffield. In the first 200 labours there were a few cases of purulent ophthalmia, but in the last 2,000 not a single case occurred.

From these several facts it seems evident that infection of the eyes usually occurs soon after birth, for otherwise it is difficult to understand what influence the method adopted by Hague and Schirmer and Porter and Korn and Snell could have had in preventing ophthalmia.

Admitting (as I think we must) that inoculation soon after birth is the commonest cause of ophthalmia in babies, it becomes easy to comprehend that the disease, as manifested by the

presence of discharge from the eyes, makes its appearance in most cases within four days of birth, as shown by the following table:

A Table showing the incubation period of cases of Ophthalmia neonatorum.

Name.	Reference.	Cases.	Incubation.		
			1-4 days.	4-8 days.	after 8 days.
Cunier ..	Fuchs' <i>Causes and Prevention of Blindness</i> , 1885.	111	48·65	48·65	2·70
Königstein	<i>Arch. für Kinderheilk.</i> , 1882.	51	62·75	33·33	3·92
v. Hecker .	<i>Arch. für Gynäk.</i> , XX, 3, 1882	100	54·00	46·00	—
Uppenkamp	<i>Dissert.</i> , Berlin, 1885.	328	58·84	35·97	3·35
Francisco ..	<i>New York Eye Hospital Reports</i> , January, 1895.	40	67·50	27·50	5·00
Köstlin ..	<i>Arch. für Gynäk.</i> , 1895.	15	53·33	26·66	13·33
Collins, E. T. ..	<i>Practitioner</i> , April, 1902.	32	78·13	12·50	9·37
Haupt . ..	<i>Klin. Monatsbl. f. Augen.</i> , 1903, II, p. 462.	62	80·64	12·90	6·45

The extensive figures quoted in 1882 by Haussmann (*Die Bindehautinfection der Neugeborenen*) dealing with 2,868 cases of ophthalmia neonatorum observed during a period of six years (1856-1861) among babies received at the Vienna Foundling Hospital, are not included in the foregoing table, since, without qualification, they would be liable to give an altogether false impression as to the frequency of secondary infections. They are as under: of the total number (2,868), 4·08 per cent. occurred within the first four days; 22·25 per cent. within the next four days; and no less than 73·67 per cent. after eight days. The great percentage-incidence after the eighth day, however, is more apparent than real, inasmuch as the greater number of admissions into the Vienna institution took place on the eighth or ninth day of life. Haussmann's figures stand alone, and must accordingly be quoted by themselves if the reader is to acquire a just idea as to their value.

As regards this table, it should be noted that all kinds of infections, primitive, primary, and secondary, (A and B), are grouped together, and that no attempt has been made to distinguish between gonorrhœal and non-gonorrhœal cases. It seems

improbable that a gonorrhœal infection contracted soon after birth would manifest itself later than the fourth day, and the table shows that roughly two-thirds of all cases appeared within that period. Cases which occur after that time, if gonorrhœal, are so-called secondary inoculations (B), as from the articles used in the lying-in room, or from the fingers of the mother, nurse, or baby, or are caused by micro-organisms other than the gonococcus :

A table is appended of my own cases, in which the gonorrhœal are distinguished from the non-gonorrhœal ophthalmias :

	Cases.	1-4 days.	4-8 days.	After 8 days.
Gonorrhœal	41	80.48	7.31	12.19
Non-gonorrhœal	35	57.14	37.14	5.77

John E. Weeks (*Medical Record*, October 20, 1900, p. 631) was responsible for the following generalisation with regard to the commencement of ophthalmia: "When the discharge first appeared on the fourth day one could be almost sure that the ophthalmia was the result of gonorrhœal infection, and this, too, whether it was of a mild or severe type." Weeks had made numerous observations on this point extending over many years, and they all justified the conclusion he had reached, which, however, is scarcely supported by the figures given above. I therefore believe that Morax (*Ann. de Gynécologie*, June, 1904, p. 327) was nearer the mark when he said that an ophthalmia, of which the beginning coincided with the first five days of life, had as many chances of being gonorrhœal as non-gonorrhœal.

The second mode of infection—namely, in the maternal passages during the progress of birth ("primary")—has often been invoked, more especially, perhaps, by ophthalmic surgeons, as the common cause of ophthalmia. But, as long ago as 1868, Stellwag von Carion strongly voiced the contrary view. "Much importance," he then wrote, "has been ascribed to the passage of the child's head through a vagina affected with blennorrhœa.

Yet this is certainly not a very frequent cause of purulent ophthalmia. The eyes of the child are closed during parturition, and are also covered by sebaceous material; hence inoculation at that time is scarcely possible" (*Treatise on the Diseases of the Eye*, translated by Hackley and Roosa, 1868, p. 316). Schirmer (1882) believed that infection during birth was almost impossible. Kaltenbach (1886) held that the danger to the eyes during the second stage of labour was not of great moment, and upon that opinion based a method of prophylaxis, as will be explained in detail later in these pages. A. von Erdberg (cf. in *Centralbl. f. Gynäk.*, June 17, 1893) also believed infection during birth to be exceedingly rare. de Wecker (*La Clinique Ophthalmologique*, January 10, 1899) did not deny the influence of instruments and digital examinations in directly infecting the baby's eyes while passing through the vagina; but, at the same time, believed that mode of infection to be exceptional. The vaginal pus, de Wecker thought, was not inoculated directly on the conjunctiva, but reached the latter through contamination of the eyelids.

While these views are, doubtless, in the main correct, few would probably be prepared to agree with Dudley S. Reynold's statement, *viz.*, "It is extremely doubtful if any case of gonorrhœal conjunctivitis has ever resulted from maternal infection in the course of natural delivery" (*Journ. Amer. Med. Association*, January 11, 1896). Auvard (*Gaz. hebdom. de Méd. et de Chir.*, October 21, 1887) thought that the occlusion of the baby's eyelids during birth was not so complete as to prevent liquid from gaining entrance to the conjunctival sac.

It was reserved for Lyman Ware (*American Journal of Obstetrics*, XV, 1882, p. 465) to suggest the existence of a provision against infection that had not occurred to the mind of other writers.* This he did in the following words: "Women with gonorrhœa, which is the most virulent of poisons, sometimes give birth to children who escape unharmed. The most probable explanation is that the instinct of the infant is superior

* de Wecker (*La Clinique Ophthalmologique*, January 10, 1899), however, seems to hint at some mechanism of the sort, since he says that the infant passes through the vagina with closed eyelids, and also turns the edge of the eyelids inwards ("mais il enroule même en dedans les bords palpébraux"). The assumption of any mechanism of the sort is altogether unnecessary.

to the knowledge of the mother, and curls its eyelids inwards and thus avoids the poison!"

Cramer (*Arch. f. Gynäk.*, L IX, 1, 1899, p. 180) actually saw two babies, born after a normal labour in the first vertex position, enter the world with ectropion of the upper eyelid—unilateral in one case and bilateral in the other. From this he argued that the eyelids may, in fact, be opened during the second stage of labour, and that infection may thereby be brought about. Saemisch, again, has suggested that, during long and tedious labours, friction between the eyelids and the maternal soft parts may displace the former, and thus allow infective material to enter the conjunctival sac. He further points out that slight movements of the eyelids may possibly occur before the head is born (*Graefe-Saemisch Handbuch der Gesamten Augenheilkunde*, Bd. V, Abt. 1, 1904).

It is, I suppose, impossible to deny that, in some cases, infective and specific secretions may be implanted in the baby's conjunctival sac by the intermediation of the so-called "contraction ring," by the external os uteri, or even by the umbilical cord. Such inoculations would be more likely to follow a breech than a vertex presentation. In asphyxia pallida, too, the eyes are generally opened whilst the baby is in the maternal passages, and in that case direct inoculation is doubtless possible. In reference to these points a case by Wintersteiner (*Weiner klin. Wochenschrift*, September 15, 1904) deserves to be quoted. A baby, delivered without instruments, entered the world with unilateral facial paralysis, with consequent inability to close the corresponding eye. It was significant that ophthalmia developed in that eye alone. The presumption, of course, was that the baby had traversed the maternal passages with one eye open.

Personally, I doubt whether infection within the maternal tract during the act of birth is by any means as common as sometimes stated. Undoubtedly, it may occur under certain peculiar conditions, such as those touched upon above, and also in face and brow presentations, or during the application of the forceps, the giving of a vaginal douche, or the making of a digital examination by the nurse or medical man. Its occurrence appears to be supported by the fact, insisted on by Haussmann, that ophthalmia is commoner in cases where the second stage of

labour is protracted, as by the large size of the foetal head (boys *v.* girls), narrowness of the maternal parts (primipara *v.* multipara), unfavourable presentations, and so forth. Admitting for a moment the truth of this generalisation, even these cases, in my opinion, are better explained by the mechanical action of the perineal edge, as first suggested by an English ophthalmic surgeon, the late P. H. Mules (*Medical Chronicle*, January, 1888). Mules's idea was that during the passage of the foetal head through the external orifice, the anterior edge of the perineum, at that moment a tight, elastic, curved cord, pressed for a longer or shorter time on the eyelids, depositing infective secretion between them. The perineal inoculation might, however, be brought about by the alternative movements of expulsion and retraction of the foetus, provided if at the time the edge of the perineum rested upon the eyelids. C. A. Veasey (*Medical and Surgical Reporter*, July 2, 1892) also regards the direct action of the taut perineum as a very frequent cause of the introduction of contagious material into the eye.

Besides, it must not be forgotten that in the urethra, Skene's ducts, and Bartholin's glands we have, as it were, reservoirs of infective material. It is a matter of current knowledge that the urethra of women is perhaps more frequently affected by the gonococcus than any other part of the genito-urinary tract.* In illustration of this fact it may be pointed out that Wellander (1889) found gonorrhœa of the urethra in 89 per cent., and Bruenski (1891) in 90 per cent., and Finger (1897) in from 75 per cent. to 90 per cent. of his cases. W. R. Pryor (*American Journal of Obstetrics*, Vol. XXXIV, 1896, p. 384) among 197 cases of gonorrhœa in loose women found the urethra involved in 90 per cent., as compared with the cervix uteri in 33 per cent. and the vagina in 3 per cent. J. W. Reichel (ref. in *Centralbl. f. Gynäk.*, May 6, 1899, p. 526) among 320 prostitutes found cervical gonorrhœa alone in 4·5 per cent., and with Bartholinitis in 9·5 per cent. with urethritis in 31 per cent., and with urethritis and Bartholinitis in 50 per cent. The urethra, indeed, may be the only part

*It is to be noted, however, that F. J. McCann, in his well-known communication on the aetiology of gonorrhœa (*Trans. Obstetrical Society of London*, Vol. XXXVIII, for 1896, p. 244), states that the cervix is more commonly infected than either the urethra or the Bartholinian glands.

of the genito-urinary tract affected, as in a couple of cases reported by Finger. With regard to the Bartholin glands, it is recognised that their ducts are commonly the seat of gonorrhœal inflammation, and the red spot, called by Sänger the "macula gonorrhœica," often seen at their mouth, is, I understand, looked upon by many obstetricians as pathognomonic of gonorrhœa. Finger (*Wien. klin. Wochenschr.*, 1897, No. 3) found them infected in about 50 per cent. of his cases.

There is no reason why, in difficult labours, especially in primiparæ, infective secretions should not be mechanically forced out of the urethra and Bartholin's glands by the pressure of the emerging head of the baby. In occipito-anterior presentations the contents of Bartholin's glands might be evacuated over the baby's face, while in occipito-posterior presentations the discharge would come from the urethra. In the first-named the Bartholinian secretion would be assisted in reaching the infant's eyes by the direct action of the perineum. Whatever the precise position of the child, the discharge might be planted directly into the eye, or else be washed into the eye by the subsequent cleansing of the baby.

I suggest that the explanation of many a case of gonococcal ophthalmia, where vaginal discharge is denied by the mother, may lie in the urethra retaining infective secretion long after gonorrhœa has vanished from other parts of the genito-urinary tract.

Evidence is now accumulating to show that the first mode of infection—namely, within the maternal passages before the commencement of the act of birth, the so-called "primitive" infection—is commoner than has been supposed, either by obstetricians or by ophthalmic surgeons.

That babies might be born with ophthalmia, or with its consequences in the shape of damaged eyes, or that the disease might occur within a few hours of birth, are facts that have been known, although perhaps not generally recognised, for many years. For that matter, their existence was alluded to by Quellmalz in 1750. Thomas Morrison (*Medical and Physical Journal*, Vol. XX, 1808, p. 57) was evidently alive to such a possibility nearly a century ago, for in speaking of ophthalmia neonatorum, he wrote that the disease "often occurs on the day

after birth, but more frequently on the third or fourth day succeeding to that event." In 1818, A. P. Demours (*Traité des Mal. des Yeux*, T. II, p. 146) described such a case in a male baby, whose eyes were swollen at birth, and for more than a month discharged thick matter and could not on that account be fully examined. The case terminated disastrously in loss of one eye and damage of the other. In 1829, G. J. Guthrie (*Lond. Med. and Physical Journal*, January, 1829, p. 5) reported a case, which ended in recovery. Hilsenburg (quoted by Haussmann, *loco citato*, p. 58) in his report on the lying-in department of the Berlin Charité for the year 1834, remarked that ophthalmia had appeared in several of the babies a few hours after birth; and a similar state of things was witnessed by Jungmann during the year 1838 at the Prague lying-in institution. In the course of the same year Hasse (*Neue Zeitschr. f. Geburtskunde*, 1838, Bd. 7, p. 439) reported a high grade of purulent inflammation in a baby at birth, but gave no further details of the case. Elsasser observed ante-partum ophthalmia 4 times among 330 cases, and Luithlen 16 times among 69 cases!

S. Crompton (*Lond. Med. Gazette*, new series, Vol. I, 1840-41, p. 432) related a case, under the immediate care of John Walker, assistant surgeon to the Manchester Eye Hospital, where a child was born with one eyeball destroyed, as the result of ophthalmia, and the cornea of the other eye more or less opaque. The case was described by Walker himself in the *Lancet* for February 8, 1840. John Christie (*Lond. Med. Gazette*, new series, Vol. II, 1840-41, p. 227) included among the causes of congenital opacity of the cornea "intra-uterine purulent inflammation of the eye." William W. Cooper (*Lond. Med. Gazette*, new series, Vol. II, 1840-41) related the case of a female infant, aged eight days, who presented, three hours after birth, a profuse discharge of purulent matter from both eyes. Edward Hocken (*Lancet*, September 2, 1843, p. 790) said, "as children are sometimes born with opaque cornea, it has been supposed that the disease sometimes occurs before birth." James Whitehead (*Provincial Medical and Surgical Journal*, 1847, p. 536) spoke of having often witnessed the existence of ophthalmia a few hours after delivery. Indeed, of the 35 cases included in his table, 3 are clearly examples of so-called "congenital" ophthalmia.

Gilbert Mackmurdo, in 1850, stated that the purulent ophthalmia of infants generally made its appearance on the third or fourth day after birth, but sometimes was not evident until a much later period, or might be present when the baby was born (*Lancet*, 1850, I, p. 658). Elsasser (*Annales d'oculistique*, January 31, 1857), amongst the 362 term babies delivered at the Stuttgart Maternity Hospital during 1853-1854, observed ophthalmia in 65. Of this number, the disease was stated to be congenital in 5—i.e., in 7·69 per cent. of the cases of ophthalmia, and in 1·38 per cent. of the total number of births.

Rivaud-Landrau (*Annales d'oculistique*, T. XXXVII, 1857, p. 66) described two cases, in both of which the eyes were destroyed. In the first, seen at the age of nine months, in the year 1842, the child had been born blind, apparently from ophthalmia neonatorum. The appearances completely resembled those of atrophy of the globe from ordinary purulent ophthalmia. This might possibly have been an instance of microphthalmos, although even that “congenital” condition is, in the opinion of some competent authorities, due to intra-uterine inflammation. Rivaud-Landrau’s second case, however, is conclusive. An emaciated baby, two days old when examined, presented indubitable signs of recent ophthalmia. The eyeballs were atrophied and “appeared as two little red balls, granulated like a strawberry, at the bottom of the orbits. There was no trace of cornea or iris.”

J. C. Wordsworth (*British Medical Journal*, May 2, 1863), writing in 1863, made this significant statement: “I have seen cases in which the lids were swollen and tense to such a degree, within a few hours after birth, that it was practically impossible to gain an accurate view of the condition of the cornea.” Giraldès (*Leçons sur les Maladies chirurgicales des Enfants*, 1869) spoke of babies entering the world with all the symptoms of ophthalmia.

Haussmann (*Die Bindegauinfektion der Neugeborenen*, 1882) maintained that intra-genital infection of the conjunctiva was commoner than stated in the text-books, a view in support of which he quoted the following figures from the Vienna Foundling Hospital:

On the frequency of the intra-genital development of Ophthalmia neonatorum, according to the medical report of the Wiener Findelhaus.

Year.	Foundlings.	Diseased on admission.	Days.		
			1	2	3
1856	8,321	263	1	2	2
1857	9,291	302	—	6	3
1858	9,691	388	5	2	9
1859	9,797	500	7	5	12
1860	9,037	394	4	3	5 ^A
1861	9,791	421	—	3	5 ^B
1862	9,955	406	—	15	9
1863	10,693	358	—	56	72 ^C
1864	11,084	298	36	33	18
1865	10,718	320	4	3	13
1866	14,124	346	3	4	4
Totals :—	112,502	3,996	60 (1.5 %)	132 (3.2 %)	152 (3.8 %)

A.—Once an affection of the cornea arose on the second day.

B.—Twice an affection of the cornea arose on the second day.

C.—Thrice an affection of the cornea arose on the third day, and twice on the fourth day. One child manifested a congenital destruction of both cornea, with prolapse of the iris, as the consequence of intra-uterine ophthalmia

Of a list of 25 cases of conjunctivitis in babies tabulated in 1893 by H. V. Würdemann (*American Journal of Ophthalmology*, May, 1893, p. 151) symptoms of disease were noted at birth in no fewer than 5, or 20 per cent. In a list of eight cases of ophthalmia neonatorum occurring in the private practice of Frank van Fleet (*The Post Graduate*, December, 1899), I observe that the symptoms dated "from birth" in two cases, and in a third the eyes are stated to have been "sore shortly after birth." Of 73 cases of ophthalmia neonatorum mentioned in Reymond's Paris Thesis (1898) three babies manifested symptoms at birth, to say nothing of twelve others

whose symptoms dated from the first day. In a series of 32 cases, E. T. Collins (*Practitioner*, 1920, p. 428) noted discharge as being present in one case at birth. From a recent communication by Golesceano (*Bull. et Mém. de la Société française d'ophthalmologie*, 1904, p. 347), I gather that amongst 186 cases symptoms of ophthalmia were present at birth in 18 instances, or 9.67 per cent.

A notable addition to our knowledge of congenital ophthalmia was made in 1902 by Queirel, of Marseilles, who in his *Leçons de Clinique Obstétricale* devoted a chapter to the subject, and reported at some length fifteen cases of the kind that he had observed in the course of his own work.* Queirel's cases are analysed in the following schema:—

* In a note presented to the French Academy of Medicine, through Professor Tarnier, Queirel had earlier expressed his conviction that in certain cases purulent ophthalmia might arise during intra-uterine life (*Bull. de l'Académie de Médecine*, Paris, T. XXIII, p. 26, 1890). The communication was relegated to a commission, but there it appears to have ended so far as the Academy was concerned. Science, however, lost nothing, since the two cases that formed the basis of Queirel's note to the Academy were published in full in his *Leçons*.

QUEIREL'S CASES OF CONGENITAL OPHTHALMIA.

Etiology.

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No.	Time before birth when membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of the Ophthalmia.	Other Remarks.
1	30 minutes.	8th month. Duration, $9\frac{1}{2}$ hours ; 3rd stage, $\frac{1}{2}$ hour.	2,900 grammes.	Pus escaping from both eyes at birth.		22 yrs. iii-para.	Cured in ten days.	
2		At term. Duration, 5 hours.	3,000 grammes.	Swelling of lids and escape of yellow citron-coloured fluid from eyes.		32 yrs. iii-para.	Inflammation disappeared on fifth day.	Baby died on 7th day, although kept in the couveuse.
3		8th month. Twins. Labour lasted 3 hours.	1,700 and 1,900 grammes respectively.	Born with ophthalmia.		ii-para.		Died on the third day from congenital feebleness.
4	3 days.	At term. During 1st stage, 4 hours ; 2nd stage, 5 mins. Placenta implanted on inferior segment. Amnion detached from chorion.	2,900 grammes.	Characteristic signs of ophthalmia at birth		25 yrs. iv-para.	Symptoms augmented until third day, and disappeared on the 11th.	Amniotic liquid normal.
5		Duration, 6 hours. On delivery, the amnion was detached from the chorion.	3,250 grammes.	Prophylactic treatment used, but 12 hours after delivery the left, and some hours later the right eye was noticed to be inflamed. A purulent coryza coincided with the ophthalmia.		23 yrs. iii-para.	Infant discharged on the 13th day.	Mother had employed for 6 weeks a daily injection of aniodol, on account of a granulous vaginitis. Developed influenza on the 5th day. Discharged on the 15th day, cured.

Ophthalmia Neonatorum.

QUEIREL'S CASES OF CONGENITAL OPHTHALMIA.

No.	Time before birth when membrane ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of the ophthalmia.	Other Remarks.
6		Placenta, 400 grs., implanted normally. Amnion detached from chorion. Dilatation, 20 hours; expulsion, $\frac{1}{2}$ hour.	2,900 grammes.	Born with swollen lids and with citron-like serosity escaping from between them.		35 yrs. i-para. Afflicted with leucorrhœa.	Cured in eight days.	
7		9 $\frac{1}{2}$ hours first stage, and 2 $\frac{1}{2}$ hours second stage. Placenta implanted normally. Amnion detached from chorion.	3,830 grammes.	Born with all the symptoms of purulent ophthalmia.		24 yrs i-para. Leucorrhœa did not seem to exist.		
8		Placenta 450 grammes. Amnion separated from chorion. Labour 6 hours 25 minutes (i.e., first stage 6 hours, and second 25 minutes).	2,100 grammes. About 7th month.	Diphtheritic ophthalmia from birth. Conjunctiva and cornea covered with a white skin.		30 yrs. iii-para.		
9		Term. Forceps delivery. Placenta inserted inferior segment. Amnion detached from chorion.	2,900 grammes. Deep depression left temporal region.	At birth yellowish pus, swollen lids, and injected conjunctiva.	Gonococci in smears. No growth in bouillon.	20 yrs. i-para.	Cured on the 8th day.	

10	30 minutes.	Not at term. First stage, 8 hours; second stage, 30 minutes.	2,100 grammes.	Ophthalmia at birth.	Gonococci and staphylococci in vaginal smears. Cured, but one cornea cloudy.	18 yrs. i-para. Gonococci in smears. Staphylococcus albus in cultures. Klebs-Löffler bacilli not found.	A grave case of the diphteroid type. Cured, but one cornea cloudy.
11	Artificial rupture shortly before birth of child.	Seventh month. Duration, 13 hours. Placenta inserted into inferior segment. Amnion detached from chorion.	1,950 grammes.	At birth, ophthalmia, with false membranes.	Born with ophthalmia.	20 yrs. i-para.	Treatment for 8 days.
12	Waters escaped before entrance to hospital.	At term. Duration, 10½ hours. Placenta normal. Amnion detached from chorion.	3,200 grammes.	Born with ophthalmia.	Born with ophthalmia.	28 yrs. i-para.	A maniotic liquid said to be clear and abundant.
13	29 hours before labour began, or 31 hours 10 mins. before birth of baby.	End of 8th month. Duration, 1 hour 10 mins. Placenta inserted in lower segment. Amnion detached from chorion.	2,350 grammes.	Born with ophthalmia.	Gonococci in smears from one eye. No growth in bouillon.	30 yrs. iv-para.	Discharged on 10th day, cured of his ophthalmia.
14	24 hours before labour began, or 36½ hours before child was born.	Not quite at term. Duration of first stage, 12 hours; and of second, 30 minutes. Amnion detached from chorion.	2,700 grammes.	Born with ophthalmia.	Born with ophthalmia.	22 yrs. i-para.	Cured on the 4th day.
15	Half-an-hour.	At term. Duration, 11½ hours. Amnion detached from chorion.	3,330 grammes.	Eyes congested at birth. Pus appeared to be deep in eyeballs.	30 yrs. iii-para.	Lasted 5 days. Affected with vaginitis and urethritis.	Amniotic fluid clear and abundant.

A glance at the fifteen (really sixteen) cases analysed above will show that a premature rupture of the membranes occurred in three cases only, where the time that elapsed between escape of the waters, on the one hand, and expulsion of the baby, on the other, was upwards of three days, $36\frac{1}{2}$ hours, and 31 hours 10 minutes respectively (Nos. 4, 13, and 14). It is evident, therefore, that the explanation of these cases of congenital ophthalmia usually given by authors, namely, that they are due to premature rupture of the membranes, applies in one-fifth only of Queirel's carefully recorded series. Indeed, this generalisation has been stretched too far by more than one writer. Thus, Reynolds Wilson (*Philadelphia Medical Journal*, April 12, 1902), who wrote in the same year as that in which Queirel published his cases, stated: "The opportunity for infection arises immediately upon rupture of the amniotic sac. The numerous instances which have been cited of intra-uterine infection have had to do with cases in which the head has been arrested in the pelvic canal for some time after the rupture of the membranes. The mistaken interpretation of the earlier of these cases has arisen from ignorance, on the part of observers, of the existence of the infective element which is present. Later the visionary belief in the possibility of the penetration of the amniotic sac by the gonococcus has misled other observers." Wilson's first statement is refuted by Queirel's experiences recorded above. It will presently be shown that Wilson's second assumption in all probability rests upon equally slender foundations.

Queirel comments upon the fact that the weight of the affected babies exceeded 3,000 grammes in four instances (26·6 per cent.), was 3,000 grammes once (6·6 per cent.), and fell below 3,000 grammes in no fewer than ten (66·6 per cent.).

The gonococeus was found in the only three cases where it was looked for.

Queirel concludes that the foetus may be attacked by gonocoecal infection, as by other infections, while still within the uterus. Accordingly, he prefers to speak of such cases as instances of "intra-uterine" rather than of "congenital" ophthalmia.

A remarkable instance of foetal infection was mentioned by C. J. Cullingworth in the course of the discussion on ophthalmia

neonatorum which took place at the Obstetrical Society of London in July, 1903 (see *Transactions*, Vol. XLV, 1904, p. 357. Cullingworth had assisted at a Cæsarian section, which resulted in the birth of a living child, who "in the course of a day or two" presented all the symptoms of acute purulent ophthalmia. It is unfortunate that more precise details cannot now be obtained of this almost unique* case.

Miss Rosa Ford and myself have recently collected thirty-five cases from the literature (*The Ophthalmoscope*, April, 1906). In our communication we defined the expression "ante-partum ophthalmia" as meaning an inflammatory affection of the conjunctiva produced while the foetus was still in the uterus by the infection of a micro-organism, the incubation period of which had partially or completely elapsed before birth. In the latter case signs of inflammation, or of its consequences, would be present when the child entered the world; while in the former they would appear within a post-natal period shorter than any accepted incubation time of the micro-organisms concerned. We took twenty-four hours as the minimum incubation of the gonococcus, and any case of ophthalmia due to that organism which occurred within twenty-four hours of birth, we included in the class described. The statement, sometimes met with in text-books, that in infants the incubation period of ophthalmia varied from a "few hours" to two or three days, we interpreted as meaning not a varying period of incubation, but a much more extensive occurrence of "congenital ophthalmia" than had been generally realised up to the time we wrote.

Although the gonococcus was the commonest organism concerned in the production of ophthalmia neonatorum, Miss Ford and I pointed out that other microbes, as the pneumococcus and the colon bacillus, might be present, and we insisted upon the point that, notwithstanding this, the same conditions as to causation would apply all round. The cases, we thought, might be analysed *en masse* without impairing the validity of our arguments.

*Another case in which ophthalmia was observed by Veit in a baby delivered by Cæsarian section is mentioned by F. Barnes in the *British Medical Journal* of November 5, 1881, p. 740. The original I have been unable to trace. A third case, almost free from fallacy, was observed by Robert Jardine (*Trans. Edin. Obstetrical Society*, Vol. XXIX, 1904, p. 151). Three hours after delivery the child, a boy weighing 9 $\frac{1}{2}$ lbs., had pus streaming from one of his eyes. The operation was performed as soon as possible after the pains commenced, but the membranes ruptured about one hour before the section was begun.

Accordingly, we grouped the cases under the several headings : 1. Time before birth when membranes ruptured ; 2. Circumstances attending labour ; 3. Condition of the baby ; 4. State of the eyes ; 5. Bacteriology ; 6. Condition of the mother ; 7. Course of the ophthalmia ; and 8. General remarks.

Since the publication of the foregoing paper, fresh cases have come to light, and some new ones have been published, so that I am now in a position to append a tabulated list of seventy-one cases. To these I can add nineteen others, which have been met with in my own practice.

ANTE-PARTUM OPHTHALMIA.
(Cases collected from the literature.)

No.	Name.	Reference.	Time before birth when the membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia.	Remarks.
1	Guthrie, A. J.	<i>Lord. Med. and Phys. Jnl.</i> , 1829, Jan., p. 5.				Seen at 3 weeks. Lids red and swollen with considerable purulent discharge. Symptoms dilated from birth.			Cured 16 days after first seen.	
2	Demours, A. P.	<i>Traité des Maladies des des Yeux</i> , 1818, T. ii., p. 146.			Male.	Seen at 5 months. Lids swollen at birth, and for more than a month discharged thick matter and could not be examined.			R. E. Sta- phyloma. L.E. sever- al corneal opacities.	
3	Cooper, W. W.	<i>Lord. Med. Gaz.</i> , 1840- 41, p. 822.				Profuse discharge of purulent matter from both eyes three hours after birth.				
4	Walker, John	<i>Lancet</i> , Febry. 8 1840.				Seen at 6 months with eyes in same condition as when born. Cornea of one eye completely sloughed and eyeball sunken. More than half of other cornea opaque.			Condition due to ophthalmia that had ran its entire course before birth.	

No.	Name.	Reference.	Time before birth when the membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia.	Remarks.
5	Whitehead,	<i>Proc. Med. and Surg. Inst.</i> 1847, p. 536. <i>Ibidem.</i>				Ophthalmia two hours after birth.		24 years. Multipara. Fluor albus.	Favourable.	16 pregnancies and abortions. Eight children affected with ophthalmia.
6	<i>Ibidem.</i>					Ophthalmia twelve hours after birth.		41 years. Chronic endocervicitis. Multipara. Fluor albus.	Favourable.	2 pregnancies and abortions. One baby affected with ophthalmia.
7	<i>Ibidem.</i>					Ophthalmia on first day.		22 years. Multipara	Died on the 8th day, uncured.	
8	Haase.									At birth a high grade of inflammation, together with purulent discharge.
9	Elsässer.									Congenital ophthalmia neonatorum.
										<i>Ann. d'ocul. listique,</i> T. 37, 1857, p. 87.

10	Rivaud-Landau.	<i>Ann. d'ocul. lisiq.</i> T. 37, 1857, p. 66.	<i>Ibidem.</i>	Parents stated that at birth the lids were red, there was slight secretion, and the eyeball was shrunken, as when seen by author. Half size of normal, like that liable to follow ophthalmia neonatorum.	Seen at 2 days old. Stated to have been "born blind." Lids red and swollen. Granulations present. Discharge, phthisis bulbi. Eyeballs half normal size.	Mother of poor constitution. No specific affection.	Evidently affected during intra-uterine life with purulent ophthalmia, leading to loss of the eyeballs and incurable blindness.	v. Hecker considered that infection arose from the liquor amni becoming contaminated with meconium prior to birth.
11			<i>Ibidem.</i>	Very wasted and of yellow tint.				
12	v. Hecker.	<i>Arch. für Gynäk.</i> Bd. XX, Heft III, p. 389.	<i>C.</i>	3 days.	Male. Born asphyxiated, 3,100 grammes.	<i>Elat.</i> 40 years. Multipara.	Favourable.	
					Violent inflammation of both eyes shown immediately after birth.			

No.	Name.	Reference	Time before birth when the membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia.	Remarks.
13	Hirschberg.	<i>Bett'rüge zur Prak.</i> <i>Aus einer Heilkunde, Berlin, 1876, p. I.</i>	3 days.	Labour easy.		Seen at 12 hours, with well-marked ophthalmia—swollen lids, pus, diffuse opacity of cornea.			R.E. small leucoma. L.E. Phthisis bulbi.	
14	Galeowski.	<i>Rechnei'd ophtat.</i> , 1877.				At birth eyes inflamed with purulent discharge. When seen by author, 48 hours later, both cornea destroyed.			Leucoma became smaller and thinner, and after some months, pupillary area of cornea had cleared.	Healthy. Multipara. Vaginal secretion.
15	Emmert, E.	<i>Archives of Ophthalm. and Otolaryg.</i> , Vol. VI, p. 524.				Seen on seventh day. R. E. dense leucoma of about one-third cornea, with trench of ulceration. Conjunctiva bulbi but little reddened.				Disappeared in a few days.
16	Haussmann.	<i>Die Bindenhautinfektion des Neugeborenen.</i> Stuttgart, 1882.		Not premature.	Presentation normal. Labour, 5 hours.					

17	Magnus.	<i>Klin. Monatsbl. f. Augen-krankh.</i> 1887, Bd. 25, p. 389.	3 days.	B a b y i n 1st vertex position.	Three or four weeks premature. Extremely weak.	Seen at 5 hours. Born with oph- thalmia. Swell- ing and discharge such as ones seen in 2nd stage. Both cornea cloudy and infiltrated, but not ulcerated.	Protracted course, but eventually did well.	Mules states that baby must have been infected <i>in utero</i> at least two days before birth or rupture of the membranes.
18	Mules.	<i>Medicat. Chronic.</i> January, 1888.		Premature at 7th mth.	Exception- ally easy.	Well-marked oph- thalmia at birth. When seen at 8 hours, presented usual symptoms of 2nd stage.	Mother suffered from gon- orrhœa.	At 10 days: less secre- tion; dif- fuse cloudy ness of right cor- nea.
20	Krönig.	<i>Central- blatt für Gynäk.</i> July 7, 1894.	4 days.	L a b o u r lasted 29 hours.	Bilateral ophthal- mia 'shortly after birth.' Both cornea opaque.	Gonococci numerous.	Purulent vaginal discharge for eight weeks. Gonococci found.	Primipara.
21	Kruken- berg.	<i>Zeitschrift f. Geburt- schulfe u. Gynäk.</i> 1882, p. 456.	45½ hours.	2nd vertex position.	One month premature. 2,150 grammes.	Swelling. Cloudi- ness of right cornea.	Gonococci in non- purulent secretion.	Eight days later, bi- lateral bienno rr- hea with lessening secretion.
22	Keller.	<i>Ibidem.</i>		1st vertex position.	30½ hours.	One eye affected, but later both discharged. Not purulent.	Gonococci found di- rectly after birth.	

Ophthalmia Neonatorum.

No.	Name.	Reference.	Time before birth when the membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia.	Remarks.
23	Feis, O.	<i>Central-blatt für Praktische Augenheilkunde</i> , Nov. 12, 1892.	54 hours.	Vaginal douche, 1½ per cent. carbolic.	2,770 grammes. Not quite at term. Length, 47 5'.	Swelling both eyes. Watery discharge. Cornea intact.	Gonococci.	xii — para. No signs or history of lues. Greenish yellow cervical discharge.	Healed in six weeks. Cornea intact.	Five macerated children born previously (abortions or births.)
24	Ahfeld.	<i>Central-blatt für Praktische Augenheilkunde</i> , April 28, 1894, p. 416.				Ophthalmia 4½ hours after birth.			Multipara. Cervical leucorrhœa.	In this case it is a question whether the inflammation was of infective origin, or had arisen from the silver nitrate used at birth.
25	Fers.	<i>Central-blatt für Praktische Augenheilkunde</i> , Aug. 1893, p. 557.	54 hours.	Labour tedious.		Well-marked double blepharitis.	Gonococci.			
26	Woods, H.	<i>Journal of Eye, Ear, and Throat Diseases</i> , Jan., 1898.			16 hours.	Eyelids red and swollen at birth. Pus present. Lower part of cornea opaque, and next day opacity of other cornea.		Primipara. <i>Ædi</i> 18 years. No leucorrhœa, but numerous gonococci found 13th day post-partum.	Both eyes lost.	

27	Reymond.	<i>Thèse d'ë</i> <i>Paris, 1898.</i>	26 hours 5 minutes. Expulsion 4 hours 45 minutes.	Term. Male. 2,900 grammes.	Bilateral ophthalmia at birth.	ii - para. Left on 12th day, with one eye cured.	Amniotic liquid normal.
28	<i>Ibidem.</i>	Precocious.	4 hours 5 minutes. Expulsion 1 hour 35 minutes.	$8\frac{1}{2}$ months. Male. 2,900 grammes.	Bilateral ophthalmia at birth.	i-para. Left on 9th day un-cured.	Amniotic liquid normal.
29	<i>Ibidem.</i>	Premature	9 hours 25 minutes. Expulsion 5 hours.	$8\frac{1}{2}$ months. Female. 2,380 grammes.	Bilateral ophthalmia at birth.	vii - para. Cured.	Amniotic liquid greenish, and very offensive.
30	Friedenwald, H.	<i>Medical News</i> , 1895, p. 257-9.	$2\frac{3}{4}$ hours.	Duration, 2 days.	2 per cent. silver nitrate used at birth.	Ch android and venereal warts. Coloured woman.	Opacities of both cornea at 28 days. Passed from observation on fifth day.
31	Eareckson, E.	<i>Ibidem.</i>	15 hours.	Face presentation.	Pus in the eyes one hour after birth.	At birth, lids much swollen and tightly closed. Muco-pus jetted out when lids opened.	At birth both cornea destroyed, and irides pro-lapsed.
32	Looten.					A day after birth chemosis probably of 24 hours' duration. One cornea involved.	
33	Feis.					<i>Ibidem.</i>	

Ophthalmia Neonatorum.

No.	Name.	Reference.	Time before birth when the membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia.	Remarks.
34	Winckel.	<i>Ibidem.</i>				Congenital ophthalmia neonatorum.				
35	Parischef.	<i>Wratch, 1892, ref. in Annales d' Oculistiques, Apl., 1893, p. 313.</i>	3 days before pain came on.	Normal. 12 hours 37 minutes.	Premature, 9 lunar months. 1,900 gr. Pitiful and feeble.	At birth eyes prominent like tumours. Upper lids swollen, red, and shining. Pronounced blennorrhoea.	Gonococci.		On 2nd day opacities of both cornea.	
36	Dubisay and Valenci.	<i>Soc. d' Obs. de Paris, June 1898. Ref. Centralbl. f. Gymn., December 10, 1898, p. 1, 350.</i>		Membranes ruptured prematurely.	Both eyes affected.		Mother admitted with colpitis granulosa. Had mastitis later.	Child died.		
37	Chavanne.	<i>Soc. d' Obs. de Paris, Nov. 9, 1898. Ref. in Rev. Gén. d' Ophthal-mologie, 1899, p. 70.</i>		3 days.	Liquor amnii smelt unpleasantly.	Premature, at 7 months.	Marked oedema of lids at birth. Serous secretion. Cornea, especially the left one, opaline.		Purulent discharge since third month of pregnancy. Numerous vegetations on labia majora and neighbouring parts of thighs.	ii — para. A abundant leucorrhcea 4 months before labour.
38	Bellouard.	<i>Thisé de Paris, 1892.</i>			Intact 8 hours before birth.	Many examinations by students.	Lids agglutinated, red, and swollen. Pus followed later.		Rapid recovery.	

39	<i>Ibidem.</i>	19 hours.	Frequent examinations.	Term. 2 kg 400 gr.	Redness and swelling of lids, and 3 days later, much thick discharge.	Rapid recovery.
40	Guilbaud.	<i>Ibidem.</i>	60 hours.	Lids enormously swollen, with pus and blood issuing from between them.	Abundant leucorrhœa.	Recovery.
41	Dianoux.	<i>Ibidem.</i>	2 days. Liquor amnii flowed away twice, 2 days and 1 day before respectively.	Born with redness of upper lid, followed on same day by swelling, and on next day by pus.	Vaginitis that had been carefully treated. 1 year before, miscarriage and puerperal fever.	One cornea in which damaged.
42	<i>Ibidem.</i>	<i>Ibidem.</i>	Rapid, 1 hour. Frequent injections of silver nitrate and of sublimate.	Credé used 1 hour after birth. Ten hours later, the lids tumefied.	Vaginal blennorrhea some months.	Speedily checked. Left eye less thoroughly Credé and suffered most.
43	Liroff.	<i>Recueil d'Ophtalmologie</i> , 1901, p. 705.	6 minutes. No second rupture seen.	Born with blennorrhea.	Gonococci in vaginal secretion.	Gonococci.
44	Okintchitz.	<i>Ibidem.</i>	1 week.			Congenital ophthalmia neonatorum.

Ophthalmia Neonatorum.

No.	Name.	Reference.	Time before birth when the membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia.	Remarks.
45	Strzeniński.	<i>Ibidem.</i>	A few minutes before birth. No second rupture seen.	Normal, about 13 hours. First vertex position.	Term. Well developed. Vulvitis.	Born with swollen lids. Seen at 4 hours. Tumefaction of lids; seropurulent discharge; small opalescence of left cornea. Later, pus abundant.	Gonococci numerous.	Multipara. Aged 26 years. Leucorrhœa, with many gonococci.	Cornea cleared in one week. Cured in 3 weeks. Fine cicatrization of palpebral conjunctiva remained.	A bystander's eye developed ophthalmia 24 hours after inoculation with discharge from the baby's eye.
46	Chanson.	<i>Revue Médica</i> Nov. 15, 1900.			Baby born in the early morning, and at daybreak the mother noticed swelling of the eyelids, and some pus around the last-named.	Lids edematous, and watery discharge at birth. Purulent secretion 2 hours later.	Very unclean. ? Vaginal discharge.	Membrane on lids. Cornea affected on 4th day. Both eyes lost.		
47	Wilson, N. L.	<i>Phil. Medical Journal</i> , Feb. 11, 1899.		Credé employed.	Male.					
48	<i>Ibidem.</i>			Credé employed	Male.	About 4 hours after birth, eyes inflamed and lids swollen.				

49	Arnaignac, H.	<i>Ann. d'acustis- que. T. 128, 1902, p. 241.</i>	<i>Ann. d'acustis- que. T. 128, 1902, p. 241.</i>	Broken by midwife $\frac{3}{4}$ hour be- fore birth of child.	Duration $1\frac{1}{2}$ hours. At eighth month.	Puny. 1786 At birth, swelling and redness of lids, cornea white and macerated. Seen on tenth day.	At birth, swelling and redness of grammes. Purulent vulvitis.	On 10th day, ulcer- ation of each con- nea and prolapse of iris. Both lenses escaped later.	Multipara. Me tritis during this pregnancy.	On 10th day, ulcer- ation of each con- nea and prolapse of iris. Both lenses escaped later.	The previous baby did not suffer from ophthalmia.	
50	Thomin, F.	<i>Thèse de Paris 1901, p. 35.</i>			Long before birth.	Ophthalmia at birth.						
51		<i>Ibidem.</i>					<i>Ibidem.</i>					
52		<i>Ibidem.</i>					<i>Ibidem.</i>					
53		<i>Ibidem.</i>					<i>Ibidem.</i>					
54		<i>Ibidem.</i>					<i>Ibidem.</i>					
55		<i>Ibidem.</i>					<i>Ibidem.</i>					
56	Zur Nedden.	<i>Klin. Monatsh. f. Augen- heilk. 1903 Vol. XXXVIII, p. 173.</i>					Breech pre- sentation, delivered by midwife	Pseudoin- fluenza bacilli in a moist pure cul- ture. B. xerosis and staphylo- cocci.				
								Both eyes swollen and watering im- mediately child was born. Next day purulent se- cretion from right. Typical ophthal- mia neonatorum.	Severe, but outcome favourable.	Mother had suf- fered for several weeks from a violent catarrh of the air passages.		

Ophthalmia Neonatorum.

No.	Name.	Reference.	Time before birth when the membranes ruptured.	Circumstances attending labour	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia.	Remarks.
57	Saemisch.	<i>Handb. der Ges. Augen.</i> 1904, p. 234, 5th Vol., 1 Abt.		Normal.		At birth one eye discharging thin syrupy matter. Seen second day with one cornea nearly destroyed, and cream-like discharge. One eye alone affected.	Gonococci not found, despite repeated investigation.	Healthy. Slight vaginal discharge.	Phthisis bulbi of one eye.	Author assumes intra-uterine infection.
58	Winter- steiner.	<i>W i e n e r klin.</i> <i>W o c h e n- s c h r i f t,</i> Sept. 15, 1904.		Not pro- tracted.		Born with ophthalmia. When seen at 12 hours, conjunctiva swollen and reddened, but little secretion.				<i>Ibidem.</i>
59	<i>Ibidem.</i>				Normal. Not pro- tracted.	Born with ophthalmia. Seen on second day with eyes in a state of florid suppuration.				
60	Ford, Rosa.	<i>The Oph- thal- mose,</i> Oct. 1, 1906.		40 minutes.		Thirty minutes after birth. Acute and typical ophthalmia.	Term. 8 lbs., 3½ ozs.			Cured in a fortnight.
61	Van Fleet, F.	<i>Post- Graduate,</i> Dec., 1889				Duration 8 h. 10 m. No douche given. Left oculo-pi- posterior. 3rd stage, 20 mins.		i — para. No history of vaginal discharge.		Profuse purulent discharge from eyes at birth.

ANTE-PARTUM OPHTHALMIA.
(Personal Cases.)

No.	Time before birth when membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia	Remarks.
1	3 days.		Jaundiced.	Born at night. Eyes noticed to be inflamed early next morning. Seen on 9th day. Purulent ophthalmia of medium severity. Both cornea hazy. Small epithelial defect lower-inner part of left cornea. Yellow discharge.	Gonococci.			
2	20 hours.	26½ hours. Instruments not used.	Term.	Right eye stated to have been running and inflamed at birth. Left eye infected 10th day. Seen at 3 weeks. Purulent ophthalmia of each eye. Cornea clear.	Gonococci.	ii—para.		
3	24 hours.		Term.	Left eye noticed to be inflamed at birth. Right eye infected a week later. Seen at one month, with bilateral ophthalmia and clear cornea.	Gonococci.	Multipara.		
4		1 hour.		Lids swollen and eyes discharging at birth. Seen at 10 days.			Cured at 10 days after treatment in casualty department.	
5				Eyes noticed to discharge at birth, and soon after lids, very swollen, Seen at 14 weeks, Bilateral ophthalmia of medium severity. Cornea clear.			B. Coli Communis.	

6	Just before birth.	Natural. 10 hours.	Term.	Left eye inflamed and running with matter at birth. Seen at 4 weeks. Palpebral conjunctiva reddened and running with water on exposure.	Crowds of pneumococci.	Good recovery. Small opacity left in each cornea.
7				Both eyes, "had" at birth. Seen at 2 weeks. Symptoms so mild as scarcely to suggest gonorrhœa. Cornea clear.		
8				Left eye inflamed and discharging matter at birth. Seen at 4 months.		
9		Natural. 14½ hours	Term.	Eyes discharged at birth. Seen at 3 weeks. Severe case, with corneal mischief. Cornea diffusely cloudy, with denser spots, but no actual ulceration. Vascular ring around each corneal margin.	Gonococci found for 60 days.	Gonococci.
10 and 11		Twins.	6¾ lbs.	Eyes inflamed within 10 hours of birth. Seen at 7 days. Ophthalmia : (a.) cornea clear; (b.) cloudiness lower half left cornea.	Gonococci.	Aetiol. 34 years. iii—para. Rheumatoid arthritides (? Gonorrhœa) last 2 years.
12		Natural. 15½ hours.	Term. 7½ lbs.	Eight or nine hours after birth both eyes noticed to be inflamed and running with matter. Ophthalmia of medium severity. Cornea clear.	Gonococci.	

Ophthalmia Neonatorum.

No.	Time before birth when membranes ruptured.	Circumstances attending labour.	Condition of Child.	State of Eyes.	Bacteriology.	Condition of Mother.	Course of Ophthalmia.	Remarks.
13	Stated to have "had no waters."	16 hours. Normal presentation.	Term.	Six hours after birth eyes noticed to be swollen like bladders. Seen at 7 days. Ophthalmia of medium severity. Cornea uniformly hazy, but not ulcerated.	No gonococci or other bacteria after repeated search.	Primipara.	Staphyloma both eyes.	Mild septic infection of infant on 25th day. Abscesses opened, but gonococci not found. Baby recovered.
14	½ hour	3 hours. Frequent examinations during labour.	Lusty infant.	½ hour after birth eyelids noticed to be swollen, with "watery and humoury discharge." Same at 1 day. Red and swollen lids and moderate amount of "meat juice" discharge. No actual pus. Chemosis. Cornea clear.	No gonococci despite careful search.	iv-para.	iv-para.	The other babies did not have bad eyes.
15	1½ hours.	Placid and well-nourished.	Mother was not touched before birth of child.	At birth, left eye "thick with matter." Right eye infected 3rd day. Seen at 22 days.—ophthalmia of medium severity. Unable to open eyes. Cream-like discharge. Palpebral conjunctiva red, thick, folded, and villous. Cornea clear.	Gonococci on 22nd day.		Gonococci on 22nd day.	Died at 2 months from syphilis. Eyes cured.
16	6 hours.	Natural. 13½ hours. One digital examination less than 30 minutes before baby was born. Placenta separated readily.	8th month. Very small child.	Eyes inflamed and muco-purulent discharge at birth. Seen at a month. Weight 3½ lbs. Puny, snuffing, and apathetic. Syphils. Lids red, not much swollen. Fair discharge of thick, yellow pus. Palpebral fissures preternaturally small. Palpebral conjunctiva thick, red, and villous.	Gonococci in pure culture.	ii-para.	ii-para.	

17	70 minutes	Natural labour lasting 8 hrs. 20 mins. No vaginal examination made. Placenta separated readily	Term.	At birth, right eyelid and discharging matter. The second eye became infected a week after birth. Seen at a month. Mild bilateral ophthalmia. Cornea clear.	Pneumococci and xerosis bacilli.	Primipara. Yellow vaginal discharge, attended with scalding on micturition, in fourth month of pregnancy.	Favourable.
18	One hour.	Ruptured by Midwife.	Natural labour lasting 5 hours.	At birth, eyelids red and swollen, with matter running from them. When examined, ophthalmia of medium severity. Cornea clear.	Gonococci.	Multipara.	Favourable.
19	34 minutes.		Labour lasted 10 hours.	Upper eyelids red and swollen at birth, with thin, sanious discharge, which 2 hours later had become like "matter."	B. pyocyanus and B. xerosis both in cultures and in smears.	Multipara. Slight leucorrhœa during this and other pregnancies.	No history of ophthalmia in other 3 children.

As regards my own cases of ante-partum ophthalmia, 19 in number, their bacteriology, as set forth in the accompanying table, does not differ materially from that of ophthalmia neonatorum in general :

A Table showing the Bacteriology of 19 personal cases of Ante-partum Ophthalmia :

				Number.	Percentage.
Gonococci	...	...	...	10	52.63
Pneumococci	...	...	...	2	10.53
B. coli	...	...	...	1	5.26
B. pyocyanus	...	...	...	1	5.26
Negative	...	...	...	5	26.32
<hr/>				<hr/>	
Totals	...	...	...	19	100.00

The material available amounts to 105 cases, *i.e.*, 19 of my own, and 86 reported by other observers, including those of Queirel. It will not be unprofitable to analyse these figures from an aetiological standpoint. It is, however, unfortunate that many of the cases have been inadequately reported, so that points vital to anything approaching a full enquiry are often conspicuous by their absence.

The current explanation of "congenital ophthalmia" is that the membranes have been ruptured many hours before the birth of the baby, with the consequence that the microbe, be it the gonococcus or otherwise, has gained admission to the conjunctival sac, where possibly the special circumstances of its environment have hastened and fostered its development. Powerful adjuvant factors may be found in digital examinations, or the application of instruments, or the employment of douches. This view was definitely put forward by Haussmann (*loco citato*, p. 55 *et seq.*), and has been espoused by many writers since his time, more especially, perhaps, by Pinard.

This may actually have taken place in 26 of the 71 cases included in the tables where the time of rupture of the membranes was mentioned. It occurred in one only of my own 19 cases. There still remain, however, 45, that is, 63.38 per cent., in

which less than the minimum incubation period, namely, twenty-four hours, elapsed between the rupture of the membranes, on the one hand, and the discovery of the ophthalmia, on the other. It is, therefore, certain that Haussmann's theory, although adequate for many cases, does not account for anything like all the reported instances of ante-partum ophthalmia.

It has been suggested that the increased warmth of the conjunctival sac *in utero* as compared with its temperature in the outside world may shorten the incubation of the gonococcus, and possibly of other organisms. The optimum temperature for the growth of the gonococcus, according to Foulerton (*Trans. Brit. Institute of Preventive Medicine*, 1897, I, p. 39), is from 35 degrees C. to 37 degrees C. The *ex-utero* temperature, 35.5 degrees C., is 2 degrees C. lower than the intra-uterine temperature, 37.5 degrees C. (Morax). This estimate substantially agrees with the observations of Silcx (*Archives of Ophthalmology*, Vol. XXII, p. 450), who found as the result of his experiments and observations on rabbits and dogs, that the temperature of the conjunctival sac was 2 degrees C. lower than that of the rectum. The figures quoted do not appear to lend much support to the view that the gonococcus is likely to be fostered by the intra-uterine temperature.

That an enhanced virulence of the gonococcus may account for unusually rapid development appears to be negatived by the fact that most of the cases of congenital ophthalmia, so far as one can judge from the details given, ran a favourable course.

Imperfect resistance to microbic action in consequence of feebleness of the babies seems to be excluded as a cause by the apparent health of a majority of the infants. At the same time, Queirel found the weight of the affected babies below normal in two-thirds of his fifteen cases.

Haussmann pointed out in 1882 (*loco citato*, p. 60), and Miss Rosa Ford (*The Ophthalmoscope*, October, 1906) has recently emphasised the fact, that, especially in multiparæ, the os usually becomes patulous some days before labour. It has been supposed that this may result in the infective elements of vaginal discharge gaining access to the cavity of the ovum, aided, it may be, by involuntary movements of the parts, or by abrasions of the chorionic epithelium, such as might occur during digital

examination, in order to determine the nature of the presentation.

Other possible explanations would be slight lateral rupture, or injury short of actual rupture, such as might occur by the injection of strong antiseptics, or damage by the nozzle of the syringe or the finger of the accoucheur.

None of the foregoing theories is adequate to explain cases where the "waters" came away a few minutes before the birth of the child, and still less such cases as those described by Walker, Rivaud-Landrau, Feis, Magnus, Woods, Chavanne, Armaignac, Saemisch, etc., where ophthalmia had apparently run its course *in utero*, leaving a damaged cornea or an atrophic eyeball. It is clear that in the latter cases inflammation, and presumably infection, had taken place several days, weeks, or months before birth. It is recognised that under exceptional circumstances bacteria may pass from the mother to the foetus through the placenta, as in typhoid, anthrax, relapsing fever, pneumonia, tubercle, and infections due to pyococci (Lubarsch, 1896). Cases are known where invasion by the bacillus *aerogenes capsulatus* added enormously to the size of the foetus and to the consequent difficulty of delivery. Probably, as surmised by J. W. Williams (*Obstetrics*, 1906, p. 141) such a transference of infective germs can take place only when the placenta and the epithelial investment of its villi are diseased. Instances of intra-uterine small-pox and measles, which are well-authenticated, stand on rather a different footing, since although they are doubtless bacterial diseases, yet their specific micro-organism has not yet been definitely identified. It has been demonstrated that gaseous substances may pass from the maternal to the foetal blood and *vice versa*, a remark that applies equally to certain chemical products in solution, as potassium cyanide, methylcene blue, and so forth. But the process in these cases may, after all, be one of simple osmosis.

The hypothesis of general systemic infection has been invoked by Armaignac (*Annales d'oculistique*, 1902, p. 241) as an alternative explanation of his case of congenital ophthalmia and vulvitis (No. 49 in the table). The foetal circulation may possibly become infected through the maternal general circulation or simply from the placental site. The concurrence of gonorrhœal synovitis on the first day of life in an infant suffering from ophthalmia, as in a case mentioned in Ashby and Wright's *Diseases of Children* (1899, p. 670), is suggestive of a common

blood infection. In that case the ocular infection might be both direct, through the liquor Amnii (which is believed to be partly of foetal origin), and indirect, through the blood-stream. Case No. 66, reported by Miss Rosa Ford, where one twin only developed ante-partum ophthalmia, tells against Armaignac's hypothesis, and so does the occasional occurrence of unilateral ophthalmia, as noted in several of the other cases.

However, while not disposed to deny altogether the possibility of systemic infection, I personally believe that most of the cases of ante-partum ophthalmia, not due to contamination following premature escape of the "waters," can be best explained on the theory of a local, intra-uterine infection. For this view there is a certain amount of evidence. A good many years ago Kühne (*Centralbl. f. die med. Wissenschaft.*, 1878, No. 20, p. 358) proved experimentally that bacteria could traverse an animal membrane, and Haussmann (*loco citato*, p. 60), that the progeny of rabbits could be inoculated without damaging the membranes. The latter author further observed, with intact membranes, a human foetus with numerous micro-organisms in the viscera and likewise in the amniotic fluid. In Chavanne's case (*Rev. générale d'ophthalmologie*, 1899, p. 70) of congenital ophthalmia the liquor Amnii is stated to have smelt unpleasantly, thus pointing to the presence in that fluid of putrefactive organisms. A case of Jeannin's mentioned by Armaignac (*loco citato*, p. 247) is even more conclusive, inasmuch as the colon bacillus and several anaërobic organisms were discovered in the foetid liquor Amnii, drawn off before rupture of the membranes. It should, perhaps, be said that this patient was in the fourth month of pregnancy, and the artificial induction of labour was necessitated by grave general illness.* Lastly, the recent experiments of Hellendahl (*Beiträge zur Geburtshilfe u. Gynäk.*, Bd. X, Heft 2) appear to establish the fact that penetration of the intact membranes by bacteria is possible. The organisms extend between the uterine wall and the membranes, and pass through the latter into the amniotic fluid.

Admitting, then, that bacteria may traverse an animal membrane, and that on occasion micro-organisms may be found

* Handfield-Jones (*Journ. of Obstet. and Gyn. of the British Empire*, April, 1907), has lately described several cases of foetid liquor amnii, in one of which coliform bacilli were found. In one of his five cases, the "waters" were offensive when the membranes first ruptured. The parallel between such cases and those of ante-partum ophthalmia is too obvious to be laboured.

in the amniotic fluid with intact membranes, we shall, to some extent, be prepared to accept the theory of intra-uterine infection. It is known that the organisms in cases of gonorrhœal endometritis or cervicitis may lurk* in the recesses of the mucous membrane, and it seems very likely that under some circumstances, which as yet are ill understood, they may pass through the chorion at a time when its vascular connection with the uterus is marked, as in the earlier months of pregnancy. They may thus reach the amnion in the later months, when it comes into close relationship with the chorion, and thereby gain the liquor Amnii. In the latter fluid they may infect the foetal conjunctiva sometime during the last months of pregnancy—that is to say, at a time when the eyelids are no longer anatomically closed, as at an earlier period of foetal life. The entrance of infection into the conjunctival sac may possibly be due to a particular disposition of the umbilical cord acting mechanically on the lids. This might explain some of the cases where a child has entered the world suffering from a unilateral conjunctivitis.

It may be surmised that what is true of the gonococcus is true also of certain other micro-organisms, as the colon bacillus and the pneumococcus. As bearing upon the argument outlined above, it may be pointed out that J. H. Parsons (*Trans. Ophthalmological Society*, Vol. XXIV, 1904, p. 47) has shown that congenital anterior staphyloma—a rare condition, of which only about twenty cases have yet been recorded—is almost certainly due to perforation of the foetal cornea, as the result of intra-uterine inflammation. There is, indeed, a tendency at the present time among ophthalmic surgeons to attribute to intra-uterine inflammation several so-called "congenital" anomalies of the eye, such as microphthalmos, once set to the account of delayed or arrested development.

Queirel (*Leçons de Clinique Obstétricale*, 1902, p. 197) made the important observation that 11 of 15 cases of congenital ophthalmia coincided with a detachment of the amnion from the chorion, a condition that, as he remarks, would certainly facilitate the penetration of the gonococcus through the single and permeable membrane. He also suggested that a malposition

* According to H. Fritsch (*Zeits. f. prak. Aerzte*, 1897, No. 1), the endometrium may alone be attacked by gonorrhœa.

of the placenta, observed in six instances, might not be without influence in the production of the condition.

Although it must be admitted that the questions involved in the causation of intra-genital ophthalmia are by no means decided, the following provisional conclusions may, I think, be drawn in respect of the condition :

1. Instances of ante-partum ophthalmia are nothing like so uncommon as generally believed.

2. Little more than one-third of the cases (36.61 per cent.) may be accounted for by a premature rupture of the membranes, allowing access of micro-organisms to the baby's conjunctival sac.

3. In the remaining cases a slight injury to the membranes, short of actual rupture, or a detachment of the amnion from the chorion, or a patulous condition of the os before pregnancy, may determine access of micro-organisms, or else infection through the uninjured membranes must be assumed to have taken place.

4. Increased temperature of the conjunctival sac *in utero*, enhanced virulence of the causative micro-organisms, lack of resistance in the babies, lateral tears of the membranes, position of the foetus in the maternal passages, and the condition of the placenta, cannot be shown to be clearly connected with the causation of congenital ophthalmia.

Allied with the subject of ante-partum ophthalmia are cases of ocular inflammation in babies born in a caul, of which three examples are known to me—the first reported by H. S. Taylor (*Brit. Med. Journ.*, March 18, 1871), the second by F. Barnes (*British Medical Journal*, November 5, 1881), and the last by Nieden (*Klin. Monatsbl. J. Augenheilkunde*, October, 1891, p. 353). In Taylor's case a female child, expelled with the bag of membranes unbroken, developed on the third day a violent purulent ophthalmia of one eye. Taylor's claim, that his case occurred "under circumstances which precluded all risk of contamination by the vaginal secretions," can be admitted only in so far as regards infection during passage through the birth-canal of the mother (primary infection). What happened was doubtless infection of the baby's eyes during the first bath (secondary infection A). In Barnes's case the baby developed ophthalmia on the second day. Here, again, it is impossible to exclude the

possibility of secondary infection. In Nieden's case the baby born in a caul, developed ophthalmia twenty-four hours later. His explanation was to the effect that the amniotic fluid had become contaminated by diffusion of the *materies morbi* through the membranes enveloping the foetus. The value of the communication is somewhat lessened by the fact that gonococci were not found in discharge from the eyes. Indeed, Max Knies (*Die Gonorr. Bindegauertkrank. und deren Behandlung*: Halle, 1896) has gone so far as to suggest that the inflammation was merely due to the vigorous preventive treatment adopted in the case, in consequence of the four earlier children having developed purulent ophthalmia. Aside from this suggestion, it might possibly have been an example of infection after birth, although, in my opinion, the short period of incubation rather tells against that view and in favour of the one espoused by Nieden himself. Still, the case is not conclusive as regards a primitive infection.

The methods of infection thus far discussed under the names "primitive" or "primary," or "secondary A" must be distinguished from another and important class, known as "secondary B," where the symptoms of ophthalmia fail to develop until some time after the fourth day from birth. With regard to the frequency of these cases opinions differ. Knies (*loco citato*) believes that they account for at least 10 per cent. of all cases. Cohn (*loco citato*, p. 57), of the 808 cases collected by him, found that 191, or 24 per cent., appeared after the fourth day. Of Groenouw's 41 gonococcal cases, 82 per cent. developed within five days of birth, and 17 per cent. later. Of Wintersteiner's 122 cases (*Wiener klin. Wochenschrift*, September 15, 1904) 40, or 32.78 per cent., were attacked after the fifth day. A reference to the figures given on page 77 of this communication will show that among 739 cases of ophthalmia reported by eight observers, 48.65 per cent. to 80.64 per cent. manifested themselves within the first four days of life. Among my own cases, where gonococcal are distinguished from non-gonococcal, 80.48 per cent. of the former and 57.14 per cent. of the latter began within the first four days (page 78).

The discrepancies between the above figures are somewhat great, varying, as they do, from 10 per cent. to 47 per cent. But we probably shall not err greatly if we regard secondary

infections (B) as being responsible for about one quarter of all cases of ophthalmia neonatorum. Of one thing I am certain, namely, that secondary infections are commoner than is generally suspected, and I am convinced that this impression, which is widespread, has in some instances led to too little attention being paid to the prevention of this form of ophthalmia.

Even in a well conducted and carefully managed maternity department instances of secondary infection may become a serious matter. This is shown in the following table by G. H. F. Reymond (*Thèse de Paris*, 1898), which shows the number of cases observed at the Clinique Baudelocque, despite all the precautions adopted, from January 1st, 1890, to December 31st, 1897 :

Year.	Live Births.	Cases of Ophthalmia.
1890	1,152	27
1891	1,571	13
1892	1,736	21
1893	1,833	24
1894	2,043	38
1895	1,957	19
1896	2,160	17
1897	2,151	27
Totals :—		186 ($= 1.27 \%$)

Secondary infections, as rightly inferred many years ago by that acute observer, James Whitehead (*Provincial Medical and Surgical Journal*, 1847, p. 536), depend, as a rule, remotely upon the same cause as is responsible for the earlier infections, namely, inoculation of the baby's eyes with infective maternal secretions. This may come about in several ways. The use in common by mother and child of towels, sponges, water, and so forth, doubtless accounts for many cases, especially in poor women confined in their own homes. Then, infective lochial secretion may be directly transferred by the finger of mother or attendant to the baby's eyes, as in a case mentioned by Queirrel

(*Leçons*, p. 186). The child's own finger, too, may be the medium of infection. It can be shown, I think, that these cases are commoner in institutions where mother and baby occupy one bed, than in others, where that is not allowed. At all events, this impression was strongly borne in upon my mind during my official visits to the various London poor-law lying-in institutions, where I was afforded abundant opportunities of inspecting the domestic arrangements closely. Secondary infections are naturally commoner among the poor in their own homes than in any well-ordered institution. At such a place as Queen Charlotte's Hospital, London, for example, the cases give us little trouble, and are now seen comparatively seldom. Many years ago Langenbeck (*Neue Chir. Bibliothek.*, Bd. 3, p. 208) commented upon the curious fact that in the lying-in hospital of Vienna, where most of the mothers suffered from leucorrhœa or gonorrhœa, ophthalmia was not common among the babies, who remained with the women; while at the foundling hospital, where the infants were deprived of their mothers, the disease was exceedingly prevalent. The infection of one baby from a second suffering from ophthalmia was once, indeed, a common event in certain Continental foundling hospitals. According to Fuchs's *Causes and Prevention of Blindness* (1885, p. 113), of the 130,104 babies admitted during twelve years to the Vienna Foundling Hospital, 5,616 were affected with ophthalmia, and of that number, not fewer than 1,413—almost 25 per cent.—contracted the disease in the hospital itself by infection. Fuchs mentions another instance, where as many as 39 per cent. contracted the disease from other children in an asylum. This scandalous state of things is now, happily, a thing of the past, owing partly to the well-nigh universal adoption of prophylactic measures in lying-in institutions, and partly to the enforcement of modern surgical cleanliness in the other places.

Among out-of-the-way causes of late infection, I have known of two instances, in the first of which the disease was derived from a nurse, who was subsequently found to be labouring under gonorrhœa, and in the second the infection, which occurred 21 days after birth, was traced to the baby sleeping in the same bed as a maternal aunt, herself affected with gonorrhœa. Sonden observed an epidemic of ophthalmia

neonatorum, in which gonococci were found in two of the mothers only, and Max Kries, in quoting this case (*Die gonorrhoeischen Bindegaukrankungen und deren Behandlung*, Halle, 1896, p. 9), mentions an epidemic which occurred in the *clientèle* of one midwife, who was herself, presumably, the source of infection. A remarkable case of secondary infection was reported by Brière in 1877 (*Annales d'oculistique*, T. LXXVIII, p. 40). A baby was born with a small nævus of the upper eyelid, which a woman undertook to cure by means of friction. Accordingly, she rubbed the growth with a fragment of warm placenta, obtained from a female of questionable reputation, with the consequence that, three days later, the eye manifested all the signs of purulent ophthalmia. A singular case, by Charbonnier and le Roux (*L'Année méd. de Caen*, 1903, p. 163) may also be quoted. These authors saw a purulent ophthalmia, with gonococci, in a baby of 13 days, and they incriminated the water used in baptism as the means whereby infection had been conveyed.

A. Pinard (*Ann. de Gynécologie et d'obstétr.*, January, 1902) in the course of an official report on ophthalmia neonatorum, presented to the French Academy of Medicine in July, 1901, argued strongly in favour of the reality of secondary infections of the eye from the surroundings of the baby. His personal evidence was of an interesting nature. At his *clinique* it had been found, as a matter of experience, that certain foster-mothers, whose own infants were healthy, when allowed to tend other babies, somehow or other managed to pass infection and thus to start small epidemics of ophthalmia. These were at once suppressed by replacing those women by others of a more intelligent and careful character. Pinard had noticed that cases of secondary ophthalmia very often meant a change in the *personnelle* of the hospital, or, in other words, a translation from experienced to inexperienced women.

There is an idea abroad that cases of secondary infection are of a mild character, an opinion, to my thinking, that stands in need of some little revision. It has been already stated that gonococcal infections are commoner during the first four days of life, while the others are more frequent after that period. It is admitted that, on the whole, the

former furnish the most dangerous type of ophthalmia and that the latter are relatively innocuous. Taken collectively, therefore, primary are doubtless more to be dreaded than secondary infections, but that is an entirely different thing from claiming that secondary infections in detail are of a mild character. It is clear that if the secondary case be due to infection with the gonococcus, it may be quite as formidable as a primary infection by the same organism. In the course of my work I have been unfortunate enough to meet with a good many eyes damaged or actually lost as the result of a secondary gonococcal ophthalmia. Credé (*Arch. f. Gynäk.*, Bd. XVIII, 1881, p. 367) recognised the existence of isolated dangerous cases of secondary ophthalmia.

The notion that late cases of ophthalmia are mild cases of ophthalmia has doubtless originated from the view that an attenuation of the specific virus accounts for the late appearance of the inflammation (Köstlin, Cohn, Lundsgaard, Glaeser, Morax). It was believed, in fact, that they represented a primary or a secondary A infection with a prolonged incubation stage. This view is evidently based on the incubation of urethral gonorrhœa, which is stated by some observers to extend on occasion to seven days (Leser), or, indeed, to the twelfth or sixteenth day (Zeissl). After all, there must be a limit to incubation. Although delayed development might possibly account for an ophthalmia on the fifth or sixth day after birth, it certainly could not be held responsible for an inflammation of the baby's eyes at the end of the second, third, or fourth week of the life. It would, in my opinion, be a mere *reductio ad absurdum* to assume that such could possibly be the case.

In connection with secondary B gonococcal infections it is important to recall the fact that the lochial discharges furnish a favourable medium for the development of the gonococcus, as pointed out by Bumm, Kroner, Krönig, and Steinbüchel. Fruhinsholz (*Ann. de Gynéc.*, Oct.-Nov., 1902) states that the organism may often be found for the first time after delivery (without any possibility of fresh infection), having been overlooked even during the later stages of pregnancy. Prince A. Morrow (*New York Medical Journal and Philadelphia Medical*

Journal, June 27, 1903) wrote: "All investigators who have had occasion to examine the lochial fluids unite in attesting that, immediately after confinement, even as early as the second day, there is an extraordinary multiplication of the gonococci. The lochial fluid is an excellent culture medium, and the gonococci are found almost in pure culture." These observations are of importance. They go some way towards explaining why a woman with chronic or latent or residual gonorrhœa may not infect her baby's eyes during parturition, and yet may do so during the puerperium by means of the lochia. It would seem, then, that the maternal infectivity increases during the puerperium, owing to the abnormal multiplication of gonococci in the lochial fluid during the first few days after the accouchement. The matter might perhaps be summed up by saying that the powers of infection stand in direct ratio to the amount of secretion and to the number of the gonococci, and in inverse ratio to the care exercised by the nurse, mother, and medical man.

3. The Contributory Factors of Infection.

The contributory causes of ophthalmia naturally assumed considerable importance in the days before the gonococcus was discovered, when the ætiology of the disease was more or less shrouded in mystery. Most of what is known on the subject was worked out then, when material was much more abundant than it happily is at the present time.

In the course of the following pages we shall pass rapidly over the accessory causes of disease.

There is a notion current that the children of primiparæ are more subject to ophthalmia neonatorum than those of multiparæ. This idea apparently originated from a loose statement made by Piringer in 1840 (*Die Blenn. am Menschenauge*, Graz, 1840) to the effect that of every five cases of ophthalmia seen at the eye *clinique*, three to four were first children. Haussmann appeared to be in substantial agreement with this statement, which he quoted in his monograph, but without adducing personal statistics. The figures furnished by several other authors, however, fail to substantiate the view, if,

indeed, they do not actually negative it. For example, James Whitehead (*Provincial Medical and Surgical Journal*, 1847, p. 536), among 35 consecutive cases of ophthalmia, found that all, with a single exception, occurred in the babies of multiparous mothers. Again, C. v. Hecker (*Arch. f. Gynäk.*, Bd. XX, Heft 3, p. 386, 1882) found, among 427 mothers whose children developed ophthalmia, that 41·19 per cent. were primiparæ and 58·31 per cent. multiparæ. Credé (*Arch. f. Gynäk.*, Bd. XXI, 1883, p. 179), among 304 mothers of ophthalmic babies ascertained that 164 (53·95 per cent.) were multiparæ and 140 (46·05 per cent.) primiparæ. He suggested, in explanation of his figures, that multiparæ suffered from gonorrhœa more frequently than primiparæ. On the other hand, Golesceano (*Bull. et Mém. de la Société française d'ophthalmologie*, 1904), among 46 children with ophthalmia, found that 27 were the offspring of primiparæ and 19 of multiparæ, i.e., 58·69 per cent. and 41·31 per cent. respectively. The cases were met with at an eye *clinique*, and it is just possible that the preponderance of the children of primiparæ may be accounted for by the very natural anxiety of the mother of a first child to seek expert advice for any soreness of her baby's eyes. F. Mittendorf (*Medical Record*, January 12, 1895, p. 57) has stated that in his practice, 65 per cent. of the cases of ophthalmia have occurred in the first-born. W. Allport (*Birmingham Medical Review*, 1903, p. 769) has gone even farther, and asserted that 80 per cent. of all cases of ophthalmia occur in the offspring of primiparous women.

Froebelius assumed a predisposition of the male infant to the development of ophthalmia. It was thought that the larger size of the male foetus caused a longer stay in the maternal passages, and thereby favoured infection of the eyes with specific secretion, supposing such to be present. In the year 1850, Elsässer (Schmidt's *Jahrbücher für die Medicin*, X, 323) and Hildebrants (*Journ. für Kinderkrankheiten*, XV, 1850, p. 134) adduced the following figures with regard to this point :

A Table showing the number of living boys and girls born at the Stuttgart Lying-In Institution, together with the percentage of each class affected with Ophthalmia neonatorum.

Year.	Boys.	Ophthalmia.	Girls.	Ophthalmia.
1833—1834	79	15·2%	67	7·4%
1848—1849	162	17·0%	168	23·8%
Totals:	241	16·1%	235	15·6%

The foregoing table illustrates the fallacy inherent to any small collection of figures. If the totals only be regarded, it will be found that the girls, who numbered 235, actually showed a larger percentage incidence of ophthalmia (19 per cent.) than the boys who numbered 241 (17 per cent.). In other words, the conclusion drawn from this point of view is diametrically opposed to that shown by the mutually destructive figures as they stand in the table. The latter, therefore, if it proves anything, proves that females are more liable to ophthalmia than males. Haussmann (*loco citato*, p. 51 *et seq.*) attempted to settle the question by analysing 18 returns from the Foundling Hospitals of St. Petersburg, Prague, and Vienna with regard to the prevalence of ophthalmia among boys and girls respectively. They came out thus: in 14 years, boys were most affected; in two years, girls were most affected; and in two years the sexes came out about equal. It should be pointed out in reference to these figures, that more male than female children were admitted to the institutions in question, which, it must be remembered, were Foundling Hospitals, where child to child infection was likely to be much commoner than in lying-in institutions. The figures quoted by Credé, however, do not lie open to this source of fallacy (*Archiv für Gynäk.*, Bd. XXI, 1883, p. 179). Of 318 babies with ophthalmia, 179, or 56·28 per cent. were boys, and 139, or 43·71 per cent. girls. C. von Hecker's figures, dealing with 430 cases of ophthalmia, tell a different tale. Of the total number of cases, 220, or 51·16 per cent., occurred in girls, and 210, or 48·83 per cent., in boys (*Archiv für Gynäk.*, Bd. XX, Heft 3, p. 386). R. Kalish (*New York Medical Journal*, October 6, 1894), denied that the disease was more frequent in boys. On the other hand, Goleseeano (*Bull. et Mém. de la Société française d'ophthalmologie*,

1904, p. 343), among 175 cases of ophthalmia, had 61.14 per cent. in males and 38.86 per cent. in females. The figures, however, as pointed out before, were derived from an eye *clinique*. Upon the whole, it must, I think, be concluded that it has yet to be proved that male children are relatively more subject to ophthalmia than female.

That the nature of the presentation was not without influence on the production of ophthalmia, was a view suggested by the earlier writers. Haussmann thought that certain presentations, such as brow or face, necessitated more frequent digital examinations and perhaps the eventual resort to instruments, thereby increasing the opportunities for direct infection of the infant's eyes. On the other hand, C. von Hecker (*loco citato*) among the mothers of 430 ophthalmic babies had 23 surgical interventions—that is to say, such occurred in 5.3 per cent. of the cases, which is no more than takes place in the ordinary run of confinements. These figures led von Hecker to conclude that ophthalmia could not be shown to be conveyed by the means or in the way suggested by Haussmann.

von Hecker, again, found that the presentation among the 430 babies had been—cranial, 415; breech, 8; and oblique, 7. The proportion of cranial presentations, 96.51 per cent., agrees closely with the proportion in normal labours, estimated at 95.5 per cent. by Pinard, at 95 per cent. by Schroeder, and (in term cases) at 96.97 per cent. by J. W. Williams. In face of these facts we must, I think, conclude that the nature of the presentation is without definite influence one way or the other.*

Credé (*Archiv für Gynäk.*, Bd. XXI, 1883, p. 179) believed that, other things being equal, infection of the baby's eyes was favoured by—1. premature rupture of the membranes, and 2. protracted second stage of the labour. With regard to the first point, Credé noted that among 270 births premature rupture of the membranes was not recorded in 65, or only about 24 per cent., while in the remainder the reverse was the case. Credé

*Cramer (*Arch. für Gynäk.*, LIX, Heft 1, p. 176), noted extreme reaction follow the use of silver drops in cases of brow and face presentation and after delivery by forceps. In explanation he suggested that the mucous membrane had suffered traumatic changes, thereby rendering it more vulnerable.

took three hours as the period beyond which he classed rupture of the membranes as " premature." With regard to the second point, a period of from one to several hours was regarded by Credé as constituting a protracted second stage. In order to bear out his view that such labours predisposed to ophthalmia, Credé adduced the figures given below :

Year.	$\frac{1}{4}$ hr.	$\frac{1}{2}$ hr.	$\frac{3}{4}$ hr.	1 hr.	2 hrs.	3 hrs.	4 hrs.	5 hrs.	6 hrs.	Over 6 hrs.
	Times.	Times.	Times.	Times.	Times.	Times.	Times.	Times.	Times.	Times.
1870	7	7	1	3	3	1	1	2	0	2
71	4	0	0	2	4	0	2	1	0	2
72	6	7	1	11	1	2	4	1	0	2
73	8	7	7	3	2	2	0	0	1	4
74	5	4	3	4	5	6	2	2	1	2
75	7	8	2	3	7	4	1	1	1	1
76	5	3	5	4	3	2	1	0	1	1
77	4	1	2	4	4	1	1	1	0	1
78	7	10	3	2	2	1	2	0	0	1
79	7	8	1	8	5	1	2	1	0	4
1880	2	3	0	1	2	0	0	0	0	2
81	0	0	1	0	0	0	0	0	0	0
82	0	1	0	1	0	0	0	0	0	0
Total.	62	59	26	46	38	20	16	9	4	22
	20.4%	19.1%	8.5%	15.5%	12.2%	6.6%	5.3%	3.0%	1.3%	7.3%

Oppenheimer (*Archiv f. Gynäk.*, Bd. XXV, Heft I, p. 51), also found that ophthalmia was most frequent when parturition had been tedious, especially in so-called "dry" births. On the other hand, Haidlen (*Centralbl. f. Gynäk.*, November 17, 1883) examined these questions, and reached conclusions opposed to those of Credé. At the Stuttgart *Hebammenschule* from 1877 to 1880—i.e., before prophylaxis was adopted—of 1,476 living babies, 172, or 11.65 per cent., developed true ophthalmia. Premature rupture of the membranes occurred in 30.37 per cent. of the 1,304 non-ophthalmic mothers, and in 37.56 per cent. of the 172 ophthalmic mothers, a proportion, according to Haidlen, only a little over the average. A protracted second stage existed in 28.99 per cent. of the former, and in 23.25 per cent. of the latter class—that is to say, in actually more of the non-ophthalmic group.

That ophthalmia is more common in illegitimate than in legitimate babies is a fact that will surprise few. At Helsingfors,

according to the figures published by Timgren (ref. in *Rev. générale d'ophtal.*, 1885, p. 119), there were during a period of thirteen years 4,155 births, with 120 cases of ophthalmia, or 2·9 per cent. Of the 4,155 mothers, 2,067 were married and 2,015 unmarried. Among the first class, 28 infants were affected with ophthalmia, and among the second 92. In other words, ophthalmia was more than three times commoner in the babies of unmarried than of married women. Some other figures tell the same tale. For example, Widmark (*Rev. gén. d'ophtalmologie*, April 30, 1888) informs us that of 4,003 natural children born during the years 1871 to 1880 at the *Allmänna Barnbordshuset* at Stockholm, 3·6 per cent. were affected with ophthalmia, whereas among 836 legitimate babies, the proportion was 1·9 per cent. only. Again, A. Heim (*Inauguraldissertation der Universität Bern*, 1895, p. 50) collected statistics concerning 378 babies affected with ophthalmia in Switzerland during the year 1892, and he found that among that number the disease attacked illegitimate twice as often as legitimate infants. Pflüger, again, (*Corres.-Blatt f. schweiz. Aerzte*, September 15, 1896), treated from 1883 to 1892, 244 cases of ophthalmia neonatorum. Illegitimate children, who formed in the Canton of Berne 5 per cent. of the total number of births, accounted for 0·93 per cent. of the cases of ophthalmia, whereas legitimate children furnished only 0·103 per cent. of the disease. In a series of 13 cases of blennorrhœa neonatorum tabulated by H. W. Würdemann (*American Journal of Ophthalmology*, May, 1893), no fewer than five occurred in illegitimate babies.

The prevalence of ophthalmia neonatorum, as will be readily understood, will stand in direct ratio to the prevalence of gonorrhœa. This latter disorder is, of course, more common in the urban than in the rural population, and ophthalmia is accordingly the same. This point is clearly brought out by the figures dealing with Switzerland given by A. Heim (*loco citato*, p. 37). Of 378 cases of ophthalmia, the origin, whether from town or country, was noted in 311. It was found that 165, or 53 per cent., originated from towns the population of which was over 5,000, while 146, or 47 per cent., came from the country. Now for the whole of Switzerland, the population proportion of town to country dwellers was as 24·64 per cent. is to 75·35 per cent., or,

roughly, as 1 is to 3. In other words, the incidence of ophthalmia was more than twice as great in the town as in the country.*

Hermann Cohn (*Ueber Verbreitung u. Verhütung der Augeneiterung der Neugeborenen*, Berlin, 1896, p. 27) found that ophthalmia was commoner in the large than in the smaller German towns, and explained the fact by the greater amount of prostitution, open and clandestine, in the former than in the latter.

The influence of season on the prevalence of ophthalmia neonatorum, as ascertained from the records of lying-in hospitals, foundling hospitals, and eye *cliniques*, has been investigated by several writers, as Carus, Haase, Wengler, Dequeuauviller, Hirschberg, Guersant, Alt, Emmert, Haussmann, and v. Hecker. C. Emmert (*Brit. Medical Journal*, October 8, 1881, p. 593) found the disease to be most frequent in May, and least frequent in December. "One thing is certain," wrote Guersant, "and that is that ophthalmia sometimes declares itself under the influence of a particular state of the atmosphere." Chrétien (*Thèse de Paris*, 1877, p. 11) believed that damp cold was among the most frequent causes of the disease, which was commonest in winter and spring, the two seasons of the year remarkable for variations in cold and humidity.

Haussmann (*loco citato*, p. 78), relying mainly upon figures from the Vienna Foundling Hospital referring to babies who contracted the disease in that institution, was inclined to think that ophthalmia was more prevalent in some months, as January, December, February, August, May, and March, than in others, as June, July, October, April, November, and September. This he attempts to explain by assuming that the opportunities for infection were more frequent in the first-named months than in the last. He suggests, for example, that the discharge from an affected eye would dry more rapidly in warm than in cold months, and that a second eye might be infected by means of contaminated dust being wafted about a room. Haussmann's theory,

* While ophthalmia, as shown above, is commoner in the town than in the country, the reverse is true of the resulting corneal damage. According to Heim's figures, damage to sight resulted in 23.97 per cent. of the 146 country cases, and in 15.15 per cent. of the 165 town cases. According to J. Widmark (*Rev. générale d'ophthalmologie*, April 30, 1888), of 142 country cases seen in the year 1885 at Stockholm, 7.7 per cent. were blinded in both eyes and 7.0 per cent. in one eye, while of 117 town cases the proportion of complete blindness was as low as 0.9 per cent. F. Park Lewis, in a recent communication (*Journal American Medical Association*, April 28, 1906), makes the significant statement that "as we leave the cities the proportion of children blind from this cause (*i.e.*, ophthalmia) multiplies prodigiously."

however, is opposed to what we know of the transmission of ophthalmia in general, which, as I have attempted to show elsewhere (*Epidemic Ophthalmia*, Edinburgh and London, 1895), is probably never air-borne, and is spread only by the direct contact of infective discharges.

In 1882, C. v. Heeker (*Arch. f. Gynäk.*, Bd. XX, Heft 3, p. 395) gave the following figures relating to the monthly incidence of ophthalmia neonatorum during a period of twenty-two years in the Munich Lying-In Institution :

A Table showing month by month the number of children born alive in the Munich Lying-In Institution, and the number of those developing ophthalmia, together with the percentage of the latter class.

Month.	Living Babies.	Babies with Ophthalmia.	Percentage with Ophthalmia.
January	1683	48	2·8
February	1662	39	2·3
March	1752	56	3·2
April	1616	36	2·2
May	1676	38	2·3
June	1479	31	2·1
July	1395	35	2·5
August	1303	25	1·9
September	1393	26	1·9
October	1490	41	2·8
November	1423	24	1·7
December	1559	31	1·9
Totals ...	18451	430	27·6

Timgren's figures dealing with 120 cases of ophthalmia (ref. in *Rev. gén. d'ophthalmologie*, 1885, p. 119) were as under :— January, 10, February, 11, March, 17, April, 9, May, 9, June, 10, July, 7, August, 7, September, 7, October, 5, November, 18, and December, 10. R. Kalish (*New York Medical Journal*, October 6, 1894) was responsible for the statement that ophthalmia was

"said to be more common during the summer in cold climates, while in hot climates the spring and autumn seem to be the favoured seasons." Leslie Buchanan (*Scottish Medical and Surgical Journal*, 1902, p. 419) investigated the seasonable variation of ophthalmia by examining the records of the Glasgow Eye Infirmary. "Climatic influences," he wrote, as the result of that examination, "cannot be proved from the monthly statistics of the Eye Infirmary in 1862-63-64-65, to have much influence, as there seems to be no period of the year in which the disease occurs markedly more frequently than at others, although cases do occur in runs," a point noticed also by Röhmer, M. J. Gibson, and many other observers.

When all is said and done, however, we must admit, with Fuchs (*Causes and Prevention of Blindness*, 1885, p. 115,) that the season of the year has not as yet been positively ascertained to have any influence upon the production of ophthalmia neonatorum.

There are certain causes that appear to predispose the newly-born baby to the contagion of ophthalmia. These may conveniently be described as 1. general, and 2. local.

1. **General Causes.**—The chief general predisposing cause lies in prematurity of the infant. It must be assumed that babies born before term present less resistance to microbic action than those who have attained a more mature growth.* This point has been recognized by numerous writers. Lawrence many years ago (*Lancet*, 1825-26, p. 628, vol. 9) said: "purulent ophthalmia is much more frequent in premature children than in those born in full time; in twins than in single children." According to Dequeuauviller (*Archives générales de Médecine*, 1843, 4^e série, Tome I and II) of 52 twins admitted to the *Hospice des Enfants Trouvés*, at Paris, in 1841, 13, or one-quarter, suffered from ophthalmia. Among the total population of the institution the proportion of those affected amounted to one-fortieth only. In 1863, J. C. Wordsworth (*British Medical Journal*, May 2, 1863) remarked: "I constantly find that the subjects of this affection are immature infants of 7 or 8 months; and that the mothers are feeble and delicate women, incapable of producing a full supply of good milk." Credé (*Arch. f. Gynak.*, Bd. XXI, 1883, p. 179) noted that in premature babies hyperæmia of the

* Infection of the eyes may, however, be predisposed to by the almost complete absence of the vernix caseosa from premature babies.

conjunctiva, together with some increased secretion, not infrequently followed the use of the silver nitrate drops recommended by that author for preventing ophthalmia neonatorum. At Queen Charlotte's Hospital, London, we used to reckon with this peculiarity by employing a weaker solution of silver nitrate than ordinary to the eyes of all babies who weighed less than five pounds at birth. Queirel (*Leçons de Clinique Obstétricale*, Paris, 1902, p. 198), expressed a confident opinion that badly-nourished or premature babies were predisposed to ophthalmia, more especially to the so-called "congenital" form of that disease.

2. **Local Causes.**—The local factors predisposing to ophthalmia are two in number—first, the absence of tears; and, secondly, certain changes in the epithelium of the conjunctiva stated to be incident to birth. With regard to the first point, it is generally assumed that the lacrymal secretion is absent from newly-born children. The eyes are therefore deprived of a protective fluid that might possibly have some action in washing away infection or in exerting bactericidal and antitoxic properties. As to the second point, Cramer (*Arch. f. Gynäk.*, Bd. LIX, Heft I, 1899, p. 165) explained the extreme reaction noted by him in premature babies, and especially in twins, after the use of Credé's method, as due to abnormal thinness and delicacy of the mucous membrane of the eyes, which in that respect agreed with the skin. A very similar view has been expressed by P Zweifel (*Centralbl. f. Gynäk.*, 1900, p. 1374). Armaignac (*Annales d'oculistique*, T. 128, 1902, p. 241) speaks of a desquamation of the oculo-palpebral surface as taking place about the time of birth, and considers this process as likely to favour the penetration of micro-organisms into the tissues. A statement to a somewhat similar effect has lately been made by W. I. Hancock (*Medical Magazine*, June, 1906), who speaks of a destruction of the conjunctival epithelium by mucoid change as a normal condition at birth.*

A few words may be added upon **vulvo-vaginitis** as it affects newly-born female children, since a close parallel exists between

*L. F. Chrétien appears to have been the first to indicate conjunctival desquamation as a most efficient predisposing factor (*Thèse de Paris*, 1877, p. 8). This process he had observed to occur from the third to the sixth day after birth.

the causation of that affection, on the one hand, and of ophthalmia neonatorum, on the other. Vulvo-vaginitis neonatorum does not appear to be a common condition. As stated earlier in the course of the present communication, it was nevertheless mentioned definitely in 1806 by Schmidt, who spoke of it as though it were a somewhat frequent occurrence. In 1847 James Whitehead mentioned cases. Coming now to more recent times, in 1889 A. F. Currier (*Medical News*, July 6, 1889, p. 3) expressed his belief that an infant might be infected in this way by its mother during the act of birth. Epstein (*Arch. f. Dermat. u. Syph.*, Band 23, 1891, p. 3) described three cases of the kind, in two of which gonorrhœal ophthalmia was also present. Morgenstein's case (*Medical Record*, February 2, 1895, p. 143) appears to have been one of vulvo-vaginitis where the infant's genitals were inoculated after birth by sleeping in the same bed as the mother, who suffered from a similar ailment. Gonococci were found in the discharge from the infant's vulva. In Koblanck's case (*Centralbl. f. Gynäk.*, July 13, 1895, p. 758) the baby developed ophthalmia on the fifth day. From the seventh to the eleventh day, there was bleeding from the vagina, associated with purulent discharge. Gonococci were found in the vaginal secretion. O. Aichel (*Hegar's Beiträge*, Bd. II, Heft 2, 1900), in reporting a case which developed in a baby on the fourth day, expressed the opinion that the condition would be found oftener if it were looked for systematically. Ophthalmia was not present. Gonococci were numerous in pus from the vulva, and in cultures diplococci and bacterium coli were found. The mother had a discharge from the urethra, in which gonococci were discovered with the microscope. In 1903, R. F. Woods (*American Journal of the Medical Sciences*, 1903, p. 311) reported an interesting case in an infant of three months, in whom a vulvo-vaginal discharge had been present since birth. The mother suffered from a discharge both from the vagina and the urethra, but gonococci could not be found. It may be mentioned that the presentation in this case had been a breech one.

A reference to the Table on pages 102 and 103, giving details of cases of ante-partum ophthalmia, will show that in two cases—namely, one reported by Strzeminski (1901) and the other by

Armaignac (1902)—congenital vulvo-vaginitis co-existed with congenital ophthalmia.

In the following case observed by me vulvo-vaginitis coincided with ophthalmia :

Case No. 13. — Elizabeth R —, aged 11 days, seen April 23, 1902. The baby, premature by about two weeks, was born, jaundiced, by breech presentation. On the fourth day both eyes became mildly inflamed, and a discharge from the "privates" was noticed. On examination, child miserably thin, with two curious-looking pemphigoid sores, one on left forearm and the other on the face (compare No. 18 in the table on page 109*). The eye symptoms were slight, included merely a little discharge and slight redness of the ocular and palpebral conjunctiva. Cornea clear. Muco-purulent discharge from vulva and vagina. *Bacteriological examination.*—(a) Eyes.—*Staphylococcus pyogenes aureus.* (b) Vagina.—Crowds of *B. coli*.

In these cases it would appear that the vulva is contaminated by infective maternal secretions much in the same way as occurs in ophthalmia neonatorum. The two conditions, as we have seen, may coincide, one may follow the other, or the vulvo-vaginitis may occur alone. They agree in another point, *viz.*, that they may be noticed some days after birth, or both may be of ante-partum origin. That the vaginal affection is no commoner depends presumably upon three factors :—first, that breech presentations are much less frequent than vertex; secondly, that the genitals are to a certain extent naturally protected against direct contact with the maternal discharges; and, thirdly, that the genitals are likely to be better cleansed than the eyes in the first bath.

Much more rarely other mucous membranes may be attacked by the gonorrhœal virus—for example, those of the mouth, nose, external ear, and rectum. Kast (*Inauguraldissertation*, Bonn, 1894) observed **gonorrhœal stomatitis** in a newly-born child without coincident ophthalmia, the infection in this case being presumably due to an intra-genital infection. Dohrn (*German Gynecological Society*, May, 1891, ref. in *Centralbl. für Gynäk.*, No. 22, 1891) reported five cases of the kind. Rosinski (*Zeitschr. f. Geb. u. Gyn.*, Bd. XXII, Heft 1 and 2, 1891) gave an account of five cases, together with an elaborate description of the naked-eye, bacteriological, and histological appearances of the condition, illustrated by coloured plates. In some of the

*Paulsen (*Münch. med. Wochenschr.*, June 18, 1901) has called attention to the fact that various skin lesions may result from inoculation by the gonococcus during birth, and has described several cases of the kind. They can be diagnosed only by finding the specific organism in the lesions. It is possible that one of the cases mentioned above belonged to this interesting group.

cases the nasal mucous membrane was also affected. The stomatitis took the form of yellowish-white *plaques*, which covered various parts of the mucous membrane. It was, upon the whole, of mild character, did not affect the general health, and speedily healed under simple treatment. Gonococci* and other microparasites were demonstrated in the exudations, as well as in microscopical sections of the affected tissues. H. Leyden (*Centralbl. f. Gynäk. u. Gerburt.*, February 24, 1894) reported a case of unilateral ophthalmia, associated on the day after its appearance with a yellowish pustule, the size of a pea, on the mucous surface of the baby's upper lip close to the gum. The other eye developed ophthalmia. Next day gonococci were found both in the discharge from the eye and in the contents of the pustule in the mouth.* The mouth healed in about nine days. Leyden believed that the infant did not become inoculated at birth, but that infective lochia from the mother, who suffered from profuse leucorrhœa during the last months of pregnancy, reached the baby's fingers, and that the infant then inoculated its eye by rubbing it with its fingers and its mouth by sucking the same members. Several years ago, before I was acquainted with Rosinski's work, I met with a case that, in the light of subsequent experience, I am inclined to think could only have been an instance of gonorrhœal stomatitis :

Case No. 14.—George P —, aged 14 days, became affected with bilateral ophthalmia, which had begun in the right eye on the third, and in the left eye on the fourth day. Gonococci were numerous in the discharge from the eyes. The cornea were clear. Noticing some dribbling from the infant's mouth, I questioned the neighbour who had brought the child to me, and was told that a sore patch had been noticed on the tongue. Upon examination, I found a raw patch, coated with some greyish debris, being about the size of a threepenny bit, on the upper surface of the tongue, not far from its tip. My notes unfortunately are silent with regard to the further progress of the case.

In the case to be next mentioned, I thought at first that I had to deal with a **gonorrhœal affection of the external auditory meatus**, but the subsequent bacteriological examination showed that I was mistaken :

Case No. 15.—Alice S —, aged 35 days, admitted Evelina Hospital, London, on May 18, 1900. Born at term after a natural labour lasting two hours. Mother affected with leucorrhœa. The right eye became inflamed on the seventh, and the left eye on the ninth day after birth. The ophthalmia was of medium severity, and intracellular groups of diplococci and cocci, not staining by Gram, were numerous in discharge from the eyes. The right cornea, although not actually ulcerated, was

*It would be necessary in such a case carefully to exclude the micrococcid catarrhalis (Kirchner), which occurs in the mouth, throat, and nose, healthy or diseased.

hazy, and surrounded by a vascular limbal ring : the left cornea showed similar but slighter changes. On June 1 the condition of the eyes was considerably improved, and but few intra-cellular cocci could be found on careful examination of the ocular secretion. On June 8 a profuse purulent discharge was noticed to flow from the right ear, a condition stated to have been present for five days. Cover-slips smeared with the material showed clumps of cocci and diplococci, staining with Gram, and in cultivations on agar, abundant growths were obtained of white and yellow pus cocci.

SUMMARY.

That a connection existed between fluor albus in the mother and ophthalmia in the child was a fact recognised by some enlightened observers towards the middle of the eighteenth century, but the view was not generally accepted until much later, when various circumstances conspired to force it upon the attention of the medical profession. For one thing, the analogy between adult gonorrhœal ophthalmia and ophthalmia neonatorum, as regards both the length of incubation and the clinical appearances, led some surgeons very early to surmise that the two represented essentially one and the same disorder. Then, the inoculation of the eyes with gonorrhœal pus as a method of curing opaque and vascular corneæ, first brought forward prominently by F. Jaeger* in 1812, showed beyond doubt that the one affection, gonorrhœa, could produce the other, purulent ophthalmia. The experiments of John Vetch in the second decade of the nineteenth century, again, rendered certain the identity of gonorrhœal ophthalmia and specific urethritis. Later in the century, Vetch's results were confirmed and extended by Piringer, by Pauli, and by Guyomar, who proved, by means of inoculations, the identity of blennorrhœa of the conjunctiva, of the urethra, and of the vagina. In the year 1879 Neisser's discovery of the gonococcus lent a fresh impetus to the study of gonorrhœal affections, including ophthalmia neonatorum. It was speedily shown that the diplococcus

*Although the introduction of inoculation is popularly assigned to Jaeger, yet an Englishman may claim priority, at least as regards the principle involved in the method. Henry Walker, writing two years before Jaeger, on the treatment of vascular cornea, said :—" Disappointed by every method hitherto introduced, I endeavoured to make the eye assume the inflammatory action of what has been called purulent ophthalmia, and to this I applied the usual remedy,—venesection. In several cases the practice has proved successful, not a single enlarged vessel remaining at the end of a fortnight" (*Edin. Med. and Surg. Journ.*, 1811, p. 5).

described by Neisser could be found not only in the secretions from specific urethritis and vaginitis, but often also in pus from the eyes of ophthalmic infants, thereby confirming bacteriologically what had for long been known experimentally. Further facts bearing upon the ætiology of ophthalmia were got from a study of a small but important class of case, where conjunctivitis was met with in female children (not necessarily babies), who were suffering at the same time from a vulvo-vaginal discharge. After Neisser's discovery, it was shown that this so-called "leucorrhœal conjunctivitis" was bacteriologically identical with ophthalmia neonatorum and gonorrhœal ophthalmia in adults, and that the vulvar discharges contained gonococci. It was proved by Zweifel, Andrews, Bumm, and Welander that the lochia of the recently delivered woman was incapable of giving rise to ophthalmia in the baby, provided the fluid was free from the specific *contagium*. It then became gradually recognised that the gonococcus was not invariably present in the discharge from ophthalmia neonatorum, although it was seldom absent from severe cases, and practically never when the cornea was involved. In short, it was recognised by those who were in a position to know the facts that there was a more or less severe type of disease, almost always associated with the gonococcus, and a milder form, associated with several other kinds of pyogenic micro-parasites. Lastly, it became acknowledged that from some cases of ophthalmia neonatorum microbes were altogether absent.

The connection between infective maternal discharges and ophthalmia admitted, it was generally believed that the infant's eyes were infected in the second stage of labour during the passage of the head through the vagina. This was the view enunciated by Lawrence and Mackenzie, and adopted for several years without being seriously challenged, except, perhaps, by Stellwag von Carion, who in 1868 pointed out reasons which rendered that view more or less untenable, one of the chief being that the child passed through the parts with closed eyelids. Ludwig Korn in 1887 and Simeon Snell in 1888 gave additional reasons for believing in the truth of v. Carion's views. Meanwhile, an impression had become widely disseminated that the first bath was closely connected with contamination of the baby's eyes (Schirmer). In the present communication it is suggested

that the most frequent site of inoculation is during the passage of the infant's head through the vulva, partly because of the presence there of the urethra and Skene's ducts and Bartholin's glands, partly by reason of the mechanical action of the anterior edge of the tightly-stretched perineum, and partly because the baby for the first time opens and shuts his eyelids as soon as the head has passed the introitus. At the same time, the influence of the first bath in producing infection is fully recognized. It is further suggested that intra-uterine or congenital or primitive infection of the baby's eyes takes place much more frequently than is generally believed, and that it is due, in most cases, to an intra-uterine infection. The disease is commoner in illegitimate than in legitimate babies, and in those born in the town than in the country. Most cases of acute ophthalmia originate from a chronic, latent, or residual gonorrhœa in the mothers, not more than 20 per cent. of whom show symptoms of acute disease at about the period of parturition. The evidence appears to lend no support to the view that the causation of ophthalmia is influenced by the size of the child, the nature of the presentation, the length of the labour, or the primiparous or multiparous state of the mother. The period of the year, also, cannot be shown to be of importance. Finally, it is pointed out that other mucous membranes of the infant, particularly those of the genital organs, may now and then be inoculated before, during, or after birth, probably by a process quite analogous to that which gives rise to inflammation of the eyes.

The ground for subsequent discussion has now been cleared by recognizing the existence of a severe form of ophthalmia, the gonococcal, and of a milder form, the outcome of the action of some other micro-organisms, of traumatism, or of certain constitutional states, especially of syphilis. It is of considerable importance to differentiate between the two types. The distinction, as will be explained immediately, is, as a rule, not difficult to establish—at all events, in a rough and ready way. Absolute differentiation, however, cannot be made in the absence of a bacteriological examination.

SYMPTOMS AND HISTOLOGY.

I. Gonorrhœal Ophthalmia.

Gonorrhœal ophthalmia, properly so-called, is nearly always recognised on the second, third, fourth, or fifth day after birth, inasmuch as the gonococci usually take that time to set up appreciable inflammatory reaction as regards the conjunctiva. v. Hecker's figures dealing with 100 cases were :—first day, 1 case ; second day, 7 cases ; third day, 19 cases ; fourth day, 27 cases ; fifth day, 23 cases ; sixth day, 14 cases ; and seventh day, 9 cases (*Archiv f. Gynäk.*, Bd. XX, Heft 3, p. 392, 1882). Uppenkamp's figures (*Dissertation*, Berlin, 1885) dealing with 328 cases were as follows :—first day, 16 cases ; second day, 38 cases ; third day, 80 cases ; fourth day, 58 cases ; fifth day, 54 cases ; sixth day, 29 cases ; seventh day, 20 cases ; eighth day, 15 cases ; ninth day, 5 cases ; tenth day, 6 cases ; and after the tenth day, 7 cases. The rule is for one eye to be affected first, and for the other to follow suit one to seven days afterwards. The disease, as a rule, eventually becomes bilateral. At the same time, unilateral cases cannot be regarded as exactly rare. For example, Kröner (*Bres. ärztl. Zeits.*, 1884) among 63 cases found one eye alone involved in 9·52 per cent. ; Cohn (*loco citato*, p. 31), among 868 cases, 25 per cent. ; Heim (*loco citato*, p. 27), among 313 cases, 19·81 per cent. ; Groenouw (*Ber. d. Oph. Ges. in Heidelberg*, 1898), among 40 cases, 7·31 per cent. ; Golesceano (*loco citato*, p. 344), among 175 cases, 20 per cent. ; Druais (*Thèse de Paris*, 1904), among 63 cases, 11 per cent. ; McKenzie and Marshall (*Royal London Ophthalmic Hospital Reports*, Vol. XIV, Pt. 2, p. 411, 1896), among 100 consecutive cases, 5 per cent. ; and myself, among 170 cases, 15 per cent. These figures (and others to the same effect might readily be quoted) make it a little difficult to understand a statement made in a recent communication by W. Allport (*Birmingham Medical Review*, 1903, p. 767), namely, that he had “never seen a case due to the gonococcus where one eye only was infected.” Even so accurate an observer as Angus McGillivray (*Scottish Medical and Surgical Journal*, 1900, Vol. VI, p. 103) says : “the disease invariably attacks both eyes ;” while John M. Batten (*Journal American Medical Association*, March 20,

1897) went the length of reporting a case of ophthalmia neonatorum simply because one eye alone was affected, a thing he had never met with in his practice before.

The earliest sign of ophthalmia that I have myself noticed is a narrow transverse red line in the centre of the upper lid, present before sero-purulent discharge makes its appearance. This I have been in the habit of calling "Billard's sign," after the name of the practitioner who was the first to describe it (*Traité des Maladies des Enfants Nouveau-nés*, 3^e édit., p. 274). Its recognition is of value, especially in maternity hospitals.* The earliest stage usually seen, however, is slight tumefaction and redness of the eyelids, from between which, when drawn apart, a drop of thin, sanguous matter wells up. Later, in severe cases the eyelids, especially the upper ones, become hot, red, swollen, glazed, and tense. The secretion becomes thick and yellow, often has a greenish tinge, and, on separating the lids, supposing that to be possible, covers all the exposed parts of the eyeball. It may in severe cases be thrown off by the inflamed conjunctiva in truly amazing quantity and with equally amazing rapidity. If the baby suffers from icterus neonatorum (no uncommon circumstance), the discharge has a yellow hue, stains linen deeply, and gives the chemical re-action for bile salts with fuming nitric acid. In certain cases it may coagulate, so as to form a thin, greyish membrane, attached but loosely to the underlying conjunctiva. The existence of these so-called "croupous" cases was known to von Graefe (*Arch. für Ophthalmologie*, Bd. I, 1854, p. 168), who, rightly enough, did not consider the condition one of diphtheria. Indeed, a pseudo-membranous product is not very uncommon in association with the gonococcus, both in babies and in older subjects. Thus, Sourdille (*Annales d'oculistique*, CXIII, 1895, p. 427) found a pseudo-membranous ophthalmia associated with gonococci, and, even on culture, nothing more was discovered except the staphylococcus pyogenes albus.

It is not uncommon in severe cases for the heavy and discoloured and stretched upper lid to overhang the lower, thus giving the baby a most characteristic appearance. When the infant cries, or the lids are touched, the latter may become everted, so

* This sign was observed by Dequevauviller 95 times, amongst 130 babies with ophthalmia at the *Hospice des Enfants Trouvés*, at Paris (*Archives générales de Médecine*, 1843, Tome I and II, 4^e série).

as to expose their mucous lining, which is then found to be shaggy, vascular, and thickened, like an everted horse's rectum, to employ a simile that is more apt than elegant. The ocular conjunctiva, nevertheless, although deeply congested, is seldom so swollen as to overlap the cornea, thereby affording an instructive contrast to the gonorrhœal ophthalmia of older subjects, where fleshy chemosis is almost always a marked feature. Now and then small ulcerations may be found upon the tarsal conjunctiva of one or other lid, a condition to which special reference has been made by Jocqs (1898 and 1890) and by Golosceano (1904). By Jocqs (*Ann. d'oculist.*, T. 103, 1890, p. 41) it is supposed that these lesions result from the pressure of the lower lid upon the conjunctival surface of the heavy and drooping upper lid, a view not shared in by Golesceano (*La Clinique Pratique des Maladies des Yeux*, December, 1906).

In the course of 24 to 48 hours, the discharge comes to resemble laudable pus in all essential particulars; later, the swelling of the lids abates and they become wrinkled, so that they can be everted without especial difficulty; and, at a later period still, the baby opens his eyes of his own accord.

Should this formidable disorder be neglected, or be badly treated, the cornea is apt to suffer in various ways. It may, for instance, become opaque in its whole extent, without visible loss of substance, and be encircled by a wider or narrower vascular ring derived from and connected with the limbus. Separate spots of ulceration may or may not appear in the cloudy cornea. As a rule, however, the opacity occurs only in that part of the cornea which, under ordinary circumstances, is not covered by the lids—the interpalpebral zone. Again, the cornea may ulcerate, especially towards the margin, the loss of substance being surrounded by more or less cloudiness. This change, like that mentioned above, is more likely to occur in the interpalpebral zone than elsewhere. It will leave an opacity, which, according to its density, is termed macula, nebula, or leucoma. The cornea, in fulminating cases (as I have myself seen), may perforate in thirty-six hours, more especially in ill-nourished or syphilitic babies. When this accident takes place, the escaping aqueous humour may carry with it the iris, so that prolapse is produced, or, much more rarely, the crystalline lens is extruded. Curiously enough, active mischief then usually ceases, and the eye is left with a corneal

opacity, to the hinder surface of which a part of the iris has become adherent (*leucoma adherens*). A bit of the iris, entangled in the corneal cicatrix, may be visible from the front as a small black point, fancifully likened to a fly's head, and on that account called *myocephalon*. Another common result of perforation is the formation of an anterior capsular cataract—that is to say, a small white permanent opacity situated on the front of the crystalline lens, in the neighbourhood of its antero-posterior axis. This stationary form of cataract, which arises only in young children, seems to be brought about in the following way :—the escaping aqueous humour carries the front of the lens against the hinder surface of the cornea, and there is thereby set up localised formative changes in the epithelium which lies beneath the lenticular capsule, the so-called anterior cubical cells. The ulcer heals, and the anterior chamber, temporarily reduced to a potential cavity only, re-forms, but there remains (a) a little mass of opaque tissue beneath the capsule of the lens, and (b) a corneal blemish. The former is permanent, but the latter may in time become almost or completely imperceptible. There may, indeed, be a second opacity lying beneath the capsular cataract, but separated from the last-named by a thin layer of transparent lens substance. A case of this sort is alluded to by E. Treacher Collins, in a communication to be found in the twelfth volume of the *Transactions of the Ophthalmological Society*, page 91. The cataract may be conical or nipple-shaped, so that it projects into the anterior chamber, when it is spoken of as "pyramidal." Wardrop (*Essays on the Morbid Anatomy of the Human Eye*, 1818, Vol. II, p. 112) mentions an instance where "the base of the pyramid rested on the capsule of the crystalline lens, and its apex passed through the pupillary opening, advancing forwards till it apparently came in contact with the transparent cornea." This state of things must be very unusual, although I have more than once seen the apex of the cone connected with the hinder surface of the cornea by a delicate strand of tissue, representing, I suppose, a stretched and organised inflammatory exudation. Cases have been reported by Mules (*Trans. Ophthalmological Society*, Vol. XIII, 1893, p. 70) and others, where threads of this kind were multiple.

Apart from these conditions, perforation of the cornea may

slowly lead to loss of sight from staphyloma, with secondary glaucoma. Less frequently, it may be quickly followed by destruction of the eye from septic inflammation of its internal tunics (panophthalmitis).

Among the remote results of severe ophthalmia we must enumerate nystagmus and squint and amblyopia. A history can usually be obtained in these cases of ophthalmia in infancy, but in the contrary event, an examination of the palpebral conjunctiva for cicatricial changes, of which something will be said presently, will generally result in a correct diagnosis.

The foregoing description applies particularly to the severer *blennorrhœal*, type of inflammation. At the same time, it is important to bear in mind that attenuated, so-called "catarrhal," forms of gonococcal ophthalmia are not very uncommon (*see p. 63*).

The **complications of gonorrhœal ophthalmia** are, to a large extent, those of gonorrhœa itself. The commonest is tenderness and tumefaction of the preauricular gland, which is in direct communication with the conjunctiva. Indeed (presumably from a mixed infection), suppuration may occur, although personally I have never witnessed this result. Then, cases have been described by Dequevauviller (*loco citato*, Tome I, p. 405), by Berger (*Arch. d'ophtal.*, T. XIV, p. 349), and by Hoeck (*Jahresber. der Ophth.*, 1894, p. 531), where abscesses occurred about the eyelids during the course of an ophthalmia. G. F. Suker (*Annals of Ophthalmology*, April, 1905) has lately reported infection of the anterior ethmoidal cells, manifesting itself clinically as an orbital cellulitis, as a complication of ophthalmia neonatorum. It appeared four days after the onset of the conjunctivitis.

A. A. Hubbell (*Ophthalmic Record*, 1903, p. 365) has reported a case of ophthalmia neonatorum complicated by double interstitial keratitis, nystagmus, and squint. The sole evidence of syphilis, however, was furnished by an elder brother, who suffered from almost total loss of accommodation in both eyes.

The occasional infection of mucous membranes other than that of the conjunctiva has been mentioned earlier in these pages.

Arthritis is a most important septic complication of ophthalmia neonatorum. In the year 1881, it is true, Poncet (*Arch. d'ophtal.*, 1881, T. I, p. 213) noted swelling of the knees and

other joints after gonorrhœal pus had been applied to an eye with pannus, and an even earlier observer, Guyomar (*Thèse de Paris*, 1858, p. 45) developed muscular rheumatism after he had placed in his own urethra pus from the eye of a baby suffering from ophthalmia. But the credit of having shown definitely that the ophthalmia of babies might be complicated with arthritis must be assigned to an Englishman, R. Clement Lucas (*British Medical Journal*, February 28, July 11, and October 10, 1885). In the same year cases were published by Widmark (*Hygeia*, 1885) and by Fendick (*British Medical Journal*, October 31, 1885). Lucas's observations have now been extended and confirmed by many other writers—as, for example, Debierre, Saswornitzky, Darier, Tyrrell, Ashby and Wright, Berenstein, R. W. Innes Smith, and Hawthorne. I have myself seen several cases of the kind. Deutschmann (v. Graefe's *Archiv für Ophthalmologie*, XXXVI, 1890, I, p. 109) noticed an acute inflammation of the knee in a baby three weeks after purulent ophthalmia, and he found gonococci, not only in the conjunctival secretion, but also in fluid obtained from the joint by puncture. Similar cases have been lately reported by Hoeck (*loco citato*), by Haushalter (*Semaine méd.*, T. XV, 1895, p. 380), by Heiman (*Medical Record*, 1898), by Paulsen (*Münch. med. Wochenschr.*, August 28, 1900), and by Altland (*Klin. Monatsbl. für Augenheilk.*, April, 1902). The infection, however, seems to be more often a mixed one. The synovitis generally attacks one of the larger joints, especially the knee or wrist, the elbow, ankle, or hip, and is often multiple. It seldom ends in suppuration. It may be associated (as I believe I was the first to point out) with effusion into the sheaths of neighbouring tendons. Its prognosis is good.

Lastly, in exceedingly rare instances, serous membranes, such as the meninges, the peritoneum, the pleura, the pericardium, or the endocardium, may be involved, or general sepsis may arise. Politzer (*Jahr. f. Kinderheilk.*, 1870, p. 335) mentioned a case where purulent conjunctivitis was followed by meningitis. Haushalter, of Nancy, has informed me that he has observed ophthalmia neonatorum followed by microcephalus and idiocy, which he ascribes to gonococci passing from the inflamed eye to the meninges and brain substance. Hoeck

(*loco citato*) reported a case where ophthalmia neonatorum was succeeded by arthritis and diffuse purulent peritonitis. Widmark (*Rev. général d'ophthalmologie*, April 30, 1888) mentioned a case where an infant with purulent ophthalmia died with the symptoms of ulcerative endocarditis. Edouard Chartres (*Thèse de Bordeaux*, 1896, p. 27) reported the death from septicæmia of a baby with bilateral gono-ophthalmia and infiltration of one cornea. The fatal result occurred when the infant was forty-one days old. E. W. Stevens (*Ophthalmic Record*, November, 1905), has reported lately a case of fatal gonorrhœal septicæmia. A fortnight after subsidence of active symptoms of ophthalmia, there was redness and swelling of a metacarpal articulation, soon followed by a similar affection of the knee, ankle, and elbow. Endocarditis was found, and the infant succumbed seventeen days after the commencement of the conjunctivitis. Gonococci were found in: (1) the maternal genital secretions, (2) the discharge from the baby's eyes, and (3) the pus from the inflamed knee-joint.

In the following case, seen recently by me, there appears to have been a condition of mild septic infection:

Case No. 16.—A baby, aged seven days, was seen on October 10, 1904, with the history that the baby was born at 4 p.m., and that at midnight, *i.e.*, six hours later, the lids of both eyes were noticed "to be swollen like bladders" and to have water running from between them. The child was born at term, without instruments, after a labour lasting sixteen hours. Presentation normal. The mother, who was a primipara, was stated "to have had no waters." Upon examination, the lids could be everted without any particular difficulty. They were stained here and there with some preparation of silver that had been used elsewhere before I had the opportunity of examining the case. The palpebral conjunctiva, especially that of the upper lid, also showed abundant evidences of active treatment. The corneaæ were so milky as to preclude any view of the deeper parts, but actual ulceration was not present. Despite repeated examination of cover-glass preparations of the discharge from the eyes, no gonococci or, indeed, any other kind of bacteria could be found. Cultures were not made. The baby was treated as an out-patient with argyrol, 25 per cent., and with permanganate of potash lotion, 1 : 5,000. On October 28, eighteen days after I first saw the baby, both corneaæ had perforated and the iris had prolapsed. On November 4, a swelling of the right wrist and of the left little finger was observed. On the following day, the baby was admitted to the Evelina Hospital as an in-patient, under the immediate care of my surgical colleague, Mr. C. H. Fagge. There was then profuse yellow discharge from both eyes, which were affected with panophthalmitis. Temperature 95·6° F. Metacarpal bone of left little finger swollen, and fluctuation could be made out. Two other fluctuating swellings were present: (1) at lower end of left ulna, and (2) at inner side of sole of left foot. The heart, lungs, and pleura showed nothing abnormal. A provisional diagnosis of pyæmia was made. On the following day (November 6) the temperature was 96° F. and 96·6° F. On November 7, under chloroform, the various swellings were opened. That on the foot proved to be a subcutaneous abscess. The others involved respectively the lower end of one ulna and the metacarpal bone of one little finger. The bone in both the situations named was bare. The operative wounds were packed with gauze and dressed in the usual way. Temperature 96·6° F., and, after operation, 95·6° F.

The baby was discharged well on November 20, 1904, after a stay in the hospital of fifteen days. Dr. A. N. Leathem, pathologist to the hospital, who examined the pus from the abscesses, reported as follows :—“ Films from the pus show a few diplococci, but these cannot be identified as gonococci. Planted on culture media suitable for the growth of gonococci, no growth of these or of any other organisms was obtained.”

In gono-ophthalmia the baby may be feverish and fretful—at all events, during the height of the disease and in severe cases. Diarrhoea, associated with green and offensive stools, is rather apt to supervene, particularly if the infant be bottle-fed.

Ophthalmia neonatorum tends towards spontaneous cure, although, as we have seen, often with impairment or loss of sight. Left to itself, active symptoms usually cease within six weeks or a couple of months ; discharge becomes watery and scanty ; the palpebral conjunctiva loses its redness, becomes papillary, and cicatricial tissue is often formed within its substance. So typical in some cases is this conjunctival scarring that a single glance at the everted lids may put one in possession of an important phase in the history of the patient, namely, the fact that he has formerly suffered severely from ophthalmia neonatorum. It would be beside my present purpose to discuss more minutely the kinds of scarring that may be observed, but I have described them fully in the twelfth volume of the *Transactions of the Ophthalmological Society of the United Kingdom* (1892). Such a case as that described by D. M. Campbell (*American Journal of Ophthalmology*, April, 1901) must be altogether exceptional. Ophthalmia was followed by an adhesion between the conjunctiva of the superior cul-de-sac and that of the tarsal plate of the upper lid, with the consequence that the upper lid was completely inverted.

Chronic blennorrhœa—that is, a condition in which redness and marked thickening of the palpebral conjunctiva and slight discharge persist for an almost indefinite time—is not common in eyes that have been treated, especially with silver nitrate. It is, in my experience, usually the outcome of a secondary inoculation with micro-organisms, more especially with the

A curious complication of ophthalmia in the baby—namely, mammary abscess in the mother—has been noted by W. J. Sinclair (1887), Legay (1887), and Cataliotti (1889), among other authors. In Sinclair's case (*Medical Chronicle*, 1887, No. 10, p. 120) gonococci appear to have been found both in the pus from the mother's breast and from the infant's eye. In Sarfert's case, also, gonococci were demonstrated (1894).

Morax-Axenfeld bacillus. The condition is analogous to the non-gonococcal gleet or leucorrhœa that may succeed to acute gonococcal infection in man or woman.

2. Non-Gonorrhœal Ophthalmia.

The milder cases of ophthalmia neonatorum, as already pointed out, are not often associated with the specific microbe of gonorrhœa. They usually occur at some period after the second, third, or fourth day from birth ; soon recover, with or without treatment ; and seldom entail damage to the corneæ. They are marked by slight puffiness of the upper lids, some little thickening of the palpebral conjunctiva, and a bloodshot appearance of the eyeball. They present merely a small quantity of mucopurulent discharge, which collects in the conjunctival sac, and when it dries on exposure to air, glues, as it were, the lashes to the skin. Their commonest bacterial causes, as explained before, are the pneumococcus, the bacillus coli, and the Koch-Weeks' bacillus. Their practical importance lies in the fact that in the absence of a microscopical examination, they are likely to be mistaken for the more serious form, an error that may cause needless alarm both to parent and to practitioner. There are no special complications.

HISTOLOGY.

The histological changes of gono-ophthalmia do not differ, except quantitatively, from those present in any ordinary case of conjunctivitis, irrespective of cause. That is to say, they include dilatation of the blood- and lymph-vessels, alterations in and desquamation of the epithelium, exudation of plasma, and infiltration of the sub-epithelial tissues with leucocytes and lymphocytes. In other words, no specific features appear to distinguish the histological changes of gonococcal inflammation of the conjunctiva.

When we come to enquire rather more closely into the pathological changes of gono-ophthalmia we find that everything centres around the cause of the inflammation, namely, the gonococcus. That micro-organism, as shown by Ernst Bumm twenty years ago (*Der Mikro-Organismus der Gonorrhœischen Schleimhaut-Erkrankungen "Gonococcus-Neisser,"* Wiesbaden,

1887), penetrates the substantia propria of the conjunctiva by passing in streaks, as it were, both between and through the epithelial cells. It there sets up the proliferative and exudative changes which we recognize with the microscope. In these changes three stages may be made out more or less clearly: first, that of penetration and exudation; secondly, that of absorption; and, thirdly, that of cicatrisation. The first stage is characterised by vacuolation of the swollen and ill-defined epithelial cells belonging to the palpebral conjunctiva, between which in places can be seen leucocytes and strings or heaps of gonococci. It is further marked by pronounced dilatation and distension of the vessels, by the exudation of red and white blood cells, and by a generalised infiltration of the loose sub-epithelial tissue of the conjunctiva with elements of which neutrophile leucocytes are the most prominent. The leucocytes, as usual, show a tendency to denser grouping in the neighbourhood of the distended blood-vessels. During this stage, the conjunctival tissues are so enormously swollen as to form papilla-like projections, from which the epithelium is often shed. In this way, actual epithelial denudations or ulcerations are brought about. These losses of substance, which may be more or less extensive, are covered with fibrin, enclosing shed epithelium and leucocytes, many of which contain gonococci. Meanwhile, the ocular conjunctiva is usually affected to a less extent, and may show nothing beyond catarrhal changes. The tarsus is stated not to participate in the diseased process. The discharge, which at first consists of tears and plasma with extravasated red blood cells, soon takes on a purulent character from admixture with leucocytes and desquamated and degenerated epithelial cells.

During the second stage, that of absorption, the changes as described above undergo gradual regression, the exudations are resorbed, the epithelium is regenerated, and the parts slowly assume something approaching their normal condition. After a severe attack, however, with epithelial denudations, fine cicatricial changes occur, which, as pointed out earlier in these pages, may become so marked, especially in the *culs-de-sac*, as to be recognized during life. Folds between neighbouring parts of the conjunctiva also may occasionally be seen.

H. Schridde (*Zeitschrift für Augenheilkunde*, December, 1905) has recently described the histological changes present in a case of ophthalmia neonatorum in a baby who died at 6½ days from broncho-pneumonia, and readers who desire more minute details are recommended to consult his original and very complete description. An earlier pathological investigation (which may also be read with advantage) was that of Horner, who examined the eyes of a baby dead forty-eight hours after the beginning of an attack of ophthalmia neonatorum (Gerhardt's *Handbuch der Kinderkrankheiten*, 1880).

DIAGNOSIS.

Any morbid secretion from the eyes of a newly-born child is far more likely to be due to some form of ophthalmia than to any other ailment. There is, however, one condition likely to be confused with ophthalmia, namely, **disease of the lacrymal sac**. These cases (altogether erroneously, as I believe) are looked upon by some surgeons as secondary to ophthalmia neonatorum. This idea appears to have had its origin in an observation made by J. Vose Solomon more than forty years ago (*British Medical Journal*, January 26, 1861), in which he described an affection of the tear-sac as a sequel to infantile purulent ophthalmia. J. W. Hulke, again, in the course of a paper upon ophthalmia neonatorum published in the *Medical Times and Gazette*, 1873 (11, p. 629), spoke of inflammation of the lacrymal sac as "an occasional and very troublesome sequel of infantile purulent ophthalmia." The statement has been repeated by other writers, as D. C. Lloyd-Owen. As a matter of fact, the condition may be described as a developmental one. The researches of modern embryology have taught us that the lacrymal sac and duct are formed from a solid rod, originating from proliferation of the epithelium at the bottom of the lacrymal groove. By liquefaction of its contents this rod eventually becomes hollow and converted into a canal lined with epithelium. The canaliculi are produced by a bifurcation of the epithelial ridge at the inner canthus. Now, if from any cause delay occurs in the elaboration of the passage, a baby may enter the world with the lumen of the lacrymal tube blocked in various ways. In some instances it is probable that the obstruction may be merely inspissated material, while in others it may be in the nature of one or several mucous folds. The researches of Rochon-Duvigneaud (*Arch. d'Ophtal.*, February, 1899) and others have shown that the lower end of the nasal duct is directed towards the mesial line, and that the canal straightens itself as the superior maxilla develops in height. The canal is divided into compartments, as it were, by partitions placed at different levels. One of the most conspicuous of these diaphragms forms a reduplicated fold at the lower end of the canal. This is often imperforate, so that the epithelial

débris filling the passage cannot escape, and may, indeed, cause the membrane to become distended bladder-wise, a condition described by Bochdalek many years ago under the name *Endblase*.

Under such conditions it needs but septic infection to produce the clinical picture of dacryocystitis. The sources of sepsis are, of course, many in number. They may be maternal or otherwise. When the child is born with a discharging lacrymal sac, infection has certainly been derived from the maternal passages, and, in my experience, a history of secretion from the genitalia is often forthcoming in such cases. On the other hand, when symptoms are not noticed for several days after birth, the source of infection is likely to be external—for example, from the baby himself or from those about him.

The micro-organisms which I have found in these cases include the pneumococcus, the xerosis bacillus, the bacillus coli, the pneumobacillus, and the staphylococcus pyogenes albus.

On examination of the infant suffering from this condition a little muco-pus can be seen to lie at the inner canthus or to glue the cilia into bundles. The eyelids are not swollen, so that the baby can open his eyes freely. The eyeball is not bloodshot. Although the palpebral conjunctiva may be somewhat hyperæmic, yet it never has the thick, red, folded, and villous appearance so characteristic of gono-ophthalmia. It is the exception for an obvious swelling to exist in the region of the lacrymal sac, *i.e.*, at the root of the nose behind the tendo oculi. Usually, however, there is a slight, ill-defined fulness of the region in question. When firm digital pressure is made over the internal palpebral ligament, muco-pus can be seen to exude from one or other punctum, and in that way a little discharge may often be squeezed into the conjunctival sinus. It is less common for compression to give rise to an escape of muco-pus from the corresponding nostril. In about three-quarters of my cases the affection has been limited to one eye. Nevertheless, it is not rare to find from the history that both eyes were attacked to begin with, and that while one has recovered spontaneously, the other has failed to do so. Most of the babies who have fallen under my notice appeared to enjoy good general health, and I feel confident that congenital syphilis did not exist

in more than 5 per cent. of the total number—that is to say, in no greater proportion than would be found in poor children brought to a hospital on account of other ailments.

It is possible to confuse these cases with those of **ophthalmia due to pneumococci**, more especially when pressure over the sac causes no regurgitation of muco-pus from the puncta. A further source of confusion lies in the fact that both affections may be accompanied by catarrh of the upper air-passages. The differential diagnosis depends mainly on three points, *viz.* : (i) dacryocystitis is usually unilateral, and ophthalmia bilateral ; (ii) dacryocystitis is accompanied by insignificant evidences of conjunctivitis ; and (iii) in dacryocystitis pressure over the lacrymal sac generally causes an escape of muco-pus from the lacrymal puncta.

As to the frequency of the condition, among 1,538 outpatients seen in the ophthalmic department of the North-Eastern Hospital for Children, London, no less than 27—or 1·75 per cent.—were affected. These figures, however, probably understate the frequency of the ailment, since there are grounds for believing that many cases get well of their own accord without treatment at hospital or elsewhere.

There is a rare disease of the cornea in infants, known as **keratomalacia**, which might be confounded with the corneal lesions of gonorrhœal ophthalmia. Rare at any age in England, keratomalacia, in my experience, is almost unknown in newly-born babies. It occurs only in babies whose general condition is extremely bad. It manifests itself by a sloughy condition of one or both corneæ, and is sometimes associated with curious, white, glistening, dry-looking patches in the ocular conjunctiva, a condition of xerosis first described by v. Graefe. Symptoms of conjunctivitis, and, for that matter, of any kind of inflammatory reaction, as a rule, are conspicuous by their absence.

Congenital opacities of the cornea must be distinguished by the history of the case and the absence of signs of inflammation of the conjunctiva.

When all is said and done, however, the diagnosis of ophthalmia neonatorum depends first and foremost upon the bacterioscopic examination of the pus from the eyes. This essential step, in my opinion, should never be omitted. Ophthalmia is an

affection that in view of its danger, one should diagnose at the earliest possible moment, in order that efficient treatment may be undertaken. As stated before, clinical inspection can never be depended upon for the purpose of distinguishing between gonocoecal and non-gonocoecal ophthalmia. Yet this is vital. Apparently mild, catarrhal, types of disease may be due to the gonococeus, while severe blennorrhœa may exceptionally be due to some other micro-organism. In order to emphasize this important point, I give below figures compiled by Groenouw (*v. Graefe's Archiv f. Ophthal.*, Bd. LII, Heft I, 1901, p. 61), which bring out the point clearly enough :

One hundred cases of Ophthalmia neonatorum, setting forth the Clinical Picture and the Bacteriology.

Type of conjunctival disease.	Gonococci.	Pneumococci.	Streptococci.	Staphylococcus pyogenes aureus	Bacterium coli.	Other pathogenic organisms.	Without typical pathogenic organisms.	Totals.
Mild Catarrh ...	1	—	1	2	2	—	10	16
Severe Catarrh...	1	5	—	2	2	—	16	26
Mild Blennorrhœa ...	9	—	1	—	2	—	10	22
Medium Blennorrhœa...	5	—	—	—	1	—	3	9
Severe Blennorrhœa ...	25	—	—	—	—	1	—	26
Other forms ...	—	—	—	—	—	—	1	1
								100

Before all things it is necessary in ophthalmia neonatorum to make a careful examination of the baby's eyes. Since this calls for the exercise of some skill and no little care, it will not be a waste of time to devote a few moments to its consideration.

The baby may be rolled in a large towel, and held face upwards upon a firm and well-lighted couch or table, when in many cases it is not difficult to examine the eyes properly. An even better plan is for the surgeon, having thrown a maeintosh sheet over his knees, to seat himself in an ordinary chair, facing a nurse, who lays the baby across her lap and at the same time secures its arms and legs. The baby's head is now steadied

between the knees of the surgeon, and in this way any serious struggling on the part of the infant is rendered well-nigh impossible. The next step is to remove every trace of pus by wool pledgets, damped with some weak antiseptic lotion, as sublimate 1 : 6,000. Placing the tip of his forefinger as close as possible to the edge of the upper lid, the surgeon then slides, as it were, the latter over the globe of the eye, most carefully avoiding anything like pressure. If the parts are slippery, or if the case does not come under notice until late in the history of the disease, it is better, rather than run any risk, to separate the eyelids with retractors instead of the fingers. One of these useful little instruments is insinuated beneath the upper lid and a second beneath the lower lid, so that on drawing them apart, the cornea may be fully exposed. If retractors be not at hand, a tolerable substitute, as pointed out by T. Gaunt (*American Journal of Obstetrics*, XV, 1882), may be made by bending a hairpin or piece of stout wire into shape. In my own work, whenever I have reason to suspect corneal mischief, I prefer to give the baby a few whiffs of chloroform or of A.C.E. or of ethyl chloride before attempting to look at the eyes. Whatever the means, the surgeon should never rest satisfied until he has fully inspected the cornea, since prognosis is largely based upon the state of that membrane.

PROGNOSIS.

The prognosis of any given case depends upon several factors, of which the more important are—the nutrition of the baby, the stage of the disease, the condition of the cornea, the size of the palpebral fissure, and, lastly, the bacterial cause and associations of the inflammation.

The nutrition of the baby.—Edward Hocken (*Lancet*, September 2, 1843) insisted upon the fact that ophthalmia was most frequent and destructive amongst weak and delicate children, and commoner in premature infants and in twins than in others (p. 791). Thomas H. Smith (*British Medical Journal*, May 30, 1863), related particulars of a case which failed to improve under treatment, although the latter was carried out with care. Finally, after four or five weeks' treatment, the mother took the baby to a homœopathic practitioner, who at once suggested a wet-nurse, with the consequence that the eyes got well in a fortnight! Haynes Walton (*Medical Times and Gazette*, May 27, 1865, p. 561) said "I have found that a premature child seldom escapes maternal infection." W. O. Moore (*Medical Record*, September 30, 1879) said, in so many words, that the virulence of ophthalmia was often due to imperfect nutrition, and very sensibly recommended that attention should be paid to the general health both of mother and child. Weeks (*Medical News*, October 20, 1900, p. 628) stated that the prognosis in any given case of ophthalmia depended upon the general health of the infant. Leslie Buchanan (*Scottish Med. and Surg. Journ.*, 1902, p. 426), speaking of cases the outcome of which is unhappy, said: "In such cases it is probable that either the general state of the patient is very poor, or that the attention given to the child's eyes is inadequate." Druais (*Thèse de Paris*, 1904, p. 30) has laid special stress upon the prognostic significance of the infant's nutrition. "Serious lesions of the cornea," he wrote, "those which lead to blindness, or to grave reduction of sight, are almost always found in badly-nourished, athrepsic children, the bearers of hereditary stigmata."

The general state of the baby, indeed, has a most important

bearing upon prognosis, and of this there is no better touchstone than systematic weighings. If a baby's weight on his first visit exceeds or at least does not fall below the average for his age, I seldom feel any misgivings as to the course of the ophthalmia ; but, in the contrary event, special precautions are always adopted, and even then an unfavourable issue is unfortunately far from uncommon.

Personally, I have known rapid destruction of the cornea to occur in premature infants and in twins. The following are cases in point :

Case No. 17.—Alfred and Helena G ——, twins, weighed when born each four pounds only. They developed ophthalmia on the third day. When they fell under my notice on the eighth day, Alfred had lost his right eye, while Helena's cornea were opaque and ulcerated. Gonococci were present, but the ophthalmic symptoms were by no means of a severe nature.

Case No. 18.—Amy E ——, 9 days, seen on December 7, 1906, with the history that both eyes became inflamed on the second day after birth. Some lotion, prescribed by the medical practitioner who attended the confinement, had been applied to the baby's eyes. She was the fifth child, but none of the others had been affected. The infant was jaundiced. Both eyes were in a state of mild blennorrhœa, the symptoms being somewhat more marked on the right side. The yellowish discharge was neither thick nor abundant. The lids could be separated without any unusual difficulty. The right cornea, however, was uniformly opaque, although without definite ulceration. The secretion, examined with the microscope, showed many threads of fibrin and relatively few polymorphonuclear leucocytes. Free cocci and diplococci were numerous, and a certain number of intra-cellular groups of diplococci were present.* In specimens stained by Gram and counter-stained by vesuvine, 0·5 per cent., no organisms retaining the gentian violet were to be seen. No growth obtained on agar-agar. It could only be assumed that the grave condition of the right cornea was due to the prematurity of the infant, who was born at the end of the eighth month, and who was obviously imperfectly developed when she fell under my notice.

Improper feeding, too, is a factor in prognosis. Other things being equal, a baby nourished by his mother has a better chance of recovering unscathed from ophthalmia than one who is bottle-fed. It is, therefore, not wise to wean a baby affected with the disease, if it can possibly be avoided. It is on this account that I never take a baby into hospital for treatment unless loss of sight appears to be imminent. At the North-Eastern Hospital for Children, London, when compelled to admit a baby suffering from ophthalmia, we always endeavour to arrange for the mother to visit the institution several times each day for the purpose of feeding the infant.

*As regards gonorrhœa, Drobny (*Archiv für Derm. u. Syph.*, October, 1898) maintained that the course of the disease was likely to be more severe and complicated when gonococci were mostly extra-cellular. In other words, extra-cellular distribution meant clinical severity.

In the case to be now related, an ill-advised attempt to wean the baby appeared to be responsible for the loss of one eye :

Case No. 19.—A baby, aged eight days, had developed ophthalmia two days before she was seen, in May, 1902. The attack was of no special severity; the corneæ were clear. Gonococci were present in discharge from the eyes. The child, who was on the breast, as the saying goes, weighed seven pounds. The patient was treated *secundum artem*, and for a few days all went well. After a fortnight's treatment, one cornea was found to be occupied by a large ulceration, and despite the use of the galvano-cautery, the iris prolapsed, the lens escaped, and the eye was lost. Enquiry elicited the fact that, after a few days' treatment, the mother had taken her child off the breast, and had fed it on condensed milk liberally diluted with water.

Children, the subject of inherited syphilis, need careful attention, since on several occasions I have observed their corneæ suffer from what appeared to be merely a mild form of ophthalmia neonatorum.

Max Kries (*loco citato*, p. 13) makes the important observation that a sudden cessation of the purulent secretion from the eyes may coincide with an attack of diarrhoea in the baby, as a prelude to a condition of keratomalacia.

Disturbance of the nursing mother's health may exert a most prejudicial influence upon the baby's ophthalmia, as in the case reported by H. V. Würdemann (*Annals of Ophthalmology*, 1896, p. 44), where an attack of gastro-enteritis in the mother led to corneal mischief in the baby, who at the moment had almost recovered from ophthalmia neonatorum.

The stage of the disease.—The earlier treatment is commenced the greater is the chance of saving sight. William Mackenzie many years ago put this somewhat obvious fact in a striking way (*Practical Treatise on the Diseases of the Eye*, fourth edition, 1854):—"whenever the person who brings the child to me," he wrote, "announces that the disease has continued for three weeks or longer, without anything having been done for its relief, I open the lids of the infant with the fearful presentiment that vision is lost, and but too often I find one or both of the corneæ gone and the iris and humours protruding. In this case it is our painful duty to say that there is no hope of sight." In 1877 L. F. Chrétien (*Thèse de Paris*, 1877, p. 41) wrote: "the sooner the malady is treated, the greater are the chances of the cornea escaping." Ayres* (ref. in *Medical Record*, August

* Original in the *Cincinnati Lancet and Observer*, January, 1876, to which I have been unable to obtain access.

26, 1893) compared 100 cases of ophthalmia seen in private practice and in the Cincinnati Lying-in Hospital respectively, and found that of the first 42 per cent. had corneal complication when first seen, whereas of the second, treated from the commencement at the Hospital, not one single cornea was affected. Heim (*Dissertation*, Berne, 1896), who reported on 378 cases of ophthalmia in Switzerland a few years back, found that among the babies treated during the first five days, 70 per cent. recovered perfectly, whereas of those treated at a later stage, only 40 per cent. got well without damage to sight.

The condition of the cornea.—A statement has been copied from text-book to text-book until it has come to be looked upon as an inviolable rule, namely, that if the cornea be clear when the baby first comes under medical care, a good prognosis is justified. This is doubtless true in most cases, but it is, I think, going too far to assert it as an absolute rule. H. Carmichael, as long ago as 1839 (*Dublin Journal of Medical Science*, Vol. XV, p. 200), recognized this fact, and courageously stated that instances had fallen under his observation where cases had done badly, although the cornea was clear when first seen. Randall (*Trans. Amer. Ophthal. Society*, 1893) reported such a case, in which both eyes were lost, in an emaciated infant, suffering from ophthalmia and a muco-sanguinolent discharge from the anus and vulva. Röhmer (*Ann. d'oculistique*, December, 1894) reported two cases where the cornea were destroyed in a couple of days, despite early treatment. Woods (*Annals of Ophthalmology and Otology*, 1894) spoke in a similar sense; and Friedenwald (*Medical News*, 1895, p. 257) has said that under the circumstances corneal mischief is an unavoidable accident in an exceedingly small number of cases. Lamhofer (Schmidt's *Jahrbücher*, 1894), again, has protested against the notion that every eye with ophthalmia should be saved if timely and suitable treatment be adopted. As Würdemann (*Annals of Ophthalmology*, 1896) has truly said: "Invidious criticism might arise if the public or profession believe that by proper treatment, given sufficiently early, blindness may in *all* cases be prevented" (p. 50). Lastly, Groenouw (*Archiv f. Ophthalmologie*, Bd. LII, Heft I, 1901, p. 33) reported several cases where the cornea became affected, despite careful treatment.

The following case may emphasize the point, which is not altogether devoid of medico-legal bearing :

Case No. 20.—Isabella H. T——, aged three weeks, was brought to the North-Eastern Hospital for Children on April 24, 1897, suffering from ophthalmia, in the discharge from which many gonococci were found. Her corneæ were then sound. The infant was treated in the usual way as an out-patient, but two days later the left cornea perforated and the iris prolapsed. The ophthalmia was eventually cured. On July 28, 1897, the left eye presented a small adherent leucoma, together with a tiny lenticular opacity.

The size of the palpebral fissure.—If the baby's eyelids are preternaturally small, as is apt to be the case in infants born before term, they press injuriously upon the eyeball, and render the application of remedies so much the more difficult. Such a state of things, therefore, is inimical to recovery without damage to the cornea, a point illustrated by the following case :

Case No. 21.—Emily O —, aged 2 months, was brought on January 10, 1897. The mother said that the eyes began to discharge on the third day after birth, and speedily became badly inflamed. They were washed with a lotion, prescribed by the medical man who attended the confinement. On examination, both corneæ were completely opaque. The palpebral fissures were so small (12 mm.) that the eyelids could be everted with the utmost difficulty. Later, the lashes of the upper lids turned in upon the eyeballs, which were meanwhile becoming staphylomatous, and so much irritation was thereby occasioned that, finally (May 26, 1897), it was necessary to excise the left eye.

The bacterial associations of the disease.—It has been repeatedly stated in these pages that the only kind of infantile ophthalmia likely to be complicated with corneal mischief is that due to the gonococcus. Clearly, therefore, a factor vital in prognosis can be recognised only by making a bacterioscopic examination of the secretion from the affected eye. In my opinion, whenever gonococci can be found by those means, no matter how mild the symptoms may appear to be, the malady should be treated with circumspection. According to E. Chartres (*Thèse de Bordeaux*, 1896, p. 40), cases associated with gonococci pure and simple, however, run a relatively benign course, and the severer types are those where streptococci occur alone or in association with gonococci. Chibret (*Rev. gén. d'ophtalmologie*, 1894, p. 269), again, holds that the danger, as regards the cornea, proceeds not from the gonococcus itself, but from its associations with staphylococci and streptococci. In view of the facts given on p. 72, as to the relative danger of the gonococcal forms as contrasted with the non-gonococcal forms of ophthalmia, it becomes difficult to agree with the conclusions reached by Chartres and Chibret.

PREVENTION.

As already stated, attempts of a primitive character have been made from remote times with the idea of preventing ophthalmia in babies. It is, however, gratifying to note that to an Englishman, Benjamin Gibson, of Manchester, who wrote in the year 1807 (*Edin. Med. and Surg. Journ.*, 1807, p. 160), we owe the first clearly reasoned description of the rational means for preventing the disease. It is difficult to believe that his words, which are quoted below, could be bettered even at the present day. They were as follows: "First, to remove, if possible, the disease in the mother during pregnancy; second, if that cannot be accomplished, to remove artificially as much of the discharge as possible from the vagina at the time of delivery; and, third, to pay, at all events, particular attention to the eyes of the child by washing them immediately after delivery with a liquid calculated to remove the offending matter or to prevent its noxious action."

That Gibson's weighty words did not fall on altogether barren soil is shown by the writings of several British authors, among whom may be specially mentioned the names of Hill, Jacob, Middlemore, Hocken, Whitehead, and Walton.

G. H. Hill (*Edin. Med. and Surg. Journ.*, 1808, p. 247), in the year after Gibson's publication, advised that when leucorrhœa existed in the mother, the membranes should not be ruptured until the last moment, so that the infant's head might remain unprotected in the vagina for as short a time as possible, and that, after birth, the eyes should be at once and carefully washed with tepid water. Arthur Jacob (article "Ophthalmia" in *Cyclopædia of Practical Medicine*, by Forbes, Tweedie, and Conolly, Vol. III, p. 198), writing in the year 1834, advised that the baby's eyes be cleansed with a sponge and warm water immediately after birth, and, if possible, before the lids were opened. Richard Middlemore (*A Treatise on the Diseases of the Eye and its Appendages*, 1835, p. 164) spoke with equal emphasis and sense upon the point. "Let me advise you," he wrote, "to guard the infant as much as possible from the hazard of contagion in those cases in which you have reason to suspect the

parent is affected with morbid vaginal discharge, not only by defending the eyes of the infant during the birth, but by directing that they be most carefully cleansed with warm milk and water immediately afterwards, and also, by requesting the nurse, or some female attendant, to give you the earliest notice of any appearance of redness or inflammation of those parts." Edward Hocken (*Lancet*, September 2, 1843), who wrote in the year 1843, said: "In all cases the prophylactic measures should be carefully taken of cleansing the eyes of newly-born infants from collections of mucus or other adherent matter." James Whitehead (*Provincial Med. and Surg. Journ.*, 1847, p. 536) advised that, if possible, the maternal passages should be brought into a healthy state prior to delivery, and that in all cases the baby's eyes should be carefully cleansed immediately after delivery. Haynes Walton, in 1865, recommended washing out the maternal passages at the commencement of parturition, and urged that the eyes of the babies of leucorrhœic mothers should be cleansed at once and inspected daily, and be treated without delay when requisite. Similar methods of prevention were equally applicable when the mother was known to be afflicted with gonorrhœa. A few years later (*Med. Times and Gazette*, November 9, 1872) the same writer said: "For many years I have pointed out that washing the eyes of a new-born babe might be a preventive measure, and insisted on the method when the presence of leucorrhœa or gonorrhœa has been detected. How far it is admissible to wash out from the vagina of the infectious mother the mucus secreted for the lubrication of the parts, is a question for the accoucheur to determine."

Elsässer, as long ago as 1835 (*Schmidt's Jahrbucher*, 1835), employed an injection of chlorine water * when the mother was affected with a vaginal discharge, and washed the child's face during labour with a similar fluid. These precautions had the desired effect.

It is of some historical interest to note that on February 27, 1837, it was proposed in the Spanish Cortes to enjoin that infants should be baptized in warm water, as it was believed

* More recently chlorine water has been recommended as a prophylactic wash by Argyll Robertson (*Edin. Med. Journ.*, 1883, p. 881) and by Schmidt-Rimpler (*Deutsch. med. Wochenschr.*, 1890, No. 31).

that ophthalmia resulted from the chill incurred in the performance of that rite.

Kehrer (ref. in *Handbuch der Gesamten Augenheilkunde*, Bd. V, Abt. I, p. 242, 1904) attempted in the year 1873 to render the contagion of ophthalmia harmless by dropping into the baby's eyes a 1 per cent. solution of silver nitrate, or by douchings of the mother's vagina, or by washing the infant's eyes with some antiseptic lotion. The results, although not ideal, were, on the whole, satisfactory. Bischoff, of Basle, was the first (1875) to douche the vagina with a solution of carbolic acid, and afterwards to wash the baby's eyes with salicylic acid. By the employment of these means during the period 1875-1876 he reduced the incidence of ophthalmia neonatorum from 5·6 per cent. to 2·6 per cent. Schiess (*Corresp.-Blatt für schweizer Aerzte*, 1876, No. 23) advised that the midwife should cleanse the baby's eyes immediately after birth with $\frac{1}{2}$ per cent. carbolic acid or $\frac{1}{10}$ per cent. thymol solution.

In 1879 we find an obscure Camberwell practitioner, Samuel Hague by name, advising that the eyes be wiped free from every trace of moisture the instant the head was born and before the baby had time to open his eyes (*Brit. Med. Journ.*, June 21 1879, p. 959). Hague quoted no figures. He stated, however, that he had attended to this point in hundreds of cases and had never known it to fail, whereas in the same period ophthalmia had repeatedly occurred in cases where the child had been born before his arrival at the house.

Abegg (*Archiv für Gynak.*, Bd. XVII, 1881, p. 502) had attained good results by simply washing the infant's eyes immediately after birth with pure water. During the period 1871-1880 there had been 2,266 births and 66 cases of ophthalmia—that is to say, about 3 per cent. Abegg (in common with many later writers) believed in adopting the very simplest methods of prevention.

Thymol, resorcin, potassium permanganate, benzoic acid, tannin, iodoform, and some other antiseptics were recommended and employed by various obstetricians.

It will therefore be apparent that the preventive treatment of ophthalmia had been practised for many years prior to 1881,

when Credé* published the first of his three memorable communications. At the same time, to Credé undoubtedly belongs the credit of having devised and systematized the most practical means of preventing ophthalmia neonatorum. This was by the application of a single drop of a 2 per cent. solution of silver nitrate, simply dropped into the baby's eyes as soon as convenient after birth.

Credé's first communication was published in the *Archiv f. Gynäkologie* for 1881 (Bd. XVII., p. 50.) He there explained that his first attempts at prevention consisted in the thorough cleansing of the vagina of pregnant women and of women actually in labour. The results, however, were not satisfactory. Credé next tried disinfection of the baby's eyes with striking success. At first all women admitted into the Leipzig Klinik with gonorrhœa or vaginal discharge were thoroughly doused with warm water or with weak (2 per cent.) solutions of carbolic or salicylic acid, as often as possible. Ophthalmia became less frequent, but did not cease.

In October, 1879, Credé tried the effect of dropping into the baby's eyes, immediately after birth, a solution of borax, 1 : 60. To begin with, this was done only in the case of babies whose mothers were diseased, and vaginal douches were still employed.

In December, 1879, the method was replaced by the injection into the eyes of a solution of silver nitrate, 1 : 40. the lids having first been carefully washed with a solution of salicylic acid, 2 : 100. From June 1, 1880, all eyes without distinction were cleansed immediately after birth with ordinary water, and then disinfected by means of silver nitrate, 1 : 50. The liquid was no longer injected beneath the lids. The exact method was as follows:—the eyelids were gently separated by an assistant, and by means of a glass rod, a single drop of the solution was placed in the eye. For twenty-four hours after the application, the eyes were cooled by means of a linen fold, soaked in salicylic acid, 2 : 100, laid over them. The vaginal douches, on the contrary, were abandoned. Babies treated in

*Carl Siegmund Franz Credé was born December 23, 1819, and died March 14, 1892. Editor of *Archiv für Gynäkologie*, which he founded. For 32 years he was the professor of obstetrics and gynecology in the University of Leipzig, and director of the Maternity Hospital connected with the University.

the way described collectively remained free from ophthalmia, despite the fact that many of the mothers manifested vaginal blennorrhœa and trachomatous colpitis. A slight hyperæmia was not uncommon after the use of the silver drops, and for the first twenty-four hours, a rather marked secretion from the eye was sometimes observed. In testimony of the success of his plan Credé adduced the following figures:—

Year.	Births.	Ophthalmia.	Percentage.
1874	323	45	13·6
1875	287	37	12·9
1876	367	29	9·1
1877	360	30	8·3
1878	353	35	9·8
1879	388	36	9·2
1880 (to May 31)	187	14	7·6
1880 (from June 1 to December 8).	200	1*	0·5

Credé's second article appeared in the *Archiv für Gynäkologie* for 1881 (Bd. XVIII, p. 367). He had treated 300 new cases by even more simple means. The cord was cut, the baby washed, the eyes were wiped with clean linen and ordinary water. The eyelids were then opened a little, and a drop of 2 per cent. silver nitrate allowed to fall into them from a glass rod. Nothing more was done. Not a single one of the 300 children treated in this way developed during the first seven days of life the least sign of ophthalmia. Babies born at term, according to Credé, showed practically no reaction.

In 1883 Credé published his third and last† and most complete communication.

* Disinfection of eyes omitted in this baby. If it were not included, the percentage of ophthalmia would be *nil*.

† This statement is not quite exact, for I find that in 1885 Credé republished, with additions, as a *brochure*, his three communications from the *Archiv für Gynäkologie*.

He recapitulated the work already accomplished, and made valuable suggestions not only as regards prevention but also as regards the aetiology of ophthalmia neonatorum (*Arch. f. Gynäk.*, Bd. XXI, 1883, p. 179). His figures extended over the thirteen years 1870 to 1882 and dealt with 4,057 babies born alive, of whom 318—that is, 7.8 per cent.—suffered from ophthalmia. Among the 316 mothers of these diseased babies, only 25, about 8 per cent., were noted as having leucorrhœa, although in 70, or 22.1 per cent., vaginitis granulosa, then as now regarded as an accompaniment of gonorrhœa, existed. Since Credé had adopted his silver method, the number of births and of cases of ophthalmia respectively had been as under :

Year.	Births.	Ophthalmia.	Percentage.
1880 (7 months) }	211	1	0.49
1881	400	1	0.25
1882	418	2	0.49
1883 (3 months) }	131	0	0.00

That was not all, for Credé explained away certain of the cases of ophthalmia, and adduced the figures quoted below as representing more closely the true state of affairs :

Year.	Births.	Ophthalmia.	Percentage.
1880	211	0	0.00
1881	400	0	0.00
1882	418	1—2	0.25—0.49
1883	131	0	0.00

Briefly, there were in nearly three years, 1,160 children born alive, and among them one case (or at most two cases) of ophthalmia. Credé claimed—not, as it seems, without ample justification—that the figures he adduced testified in the most eloquent way to the success of his method of preventing

ophthalmia. On this point there can, indeed, be no difference of opinion.

Results such as those quoted above, coming, as they did, from an obstetrician so eminent as Credé, at once excited lively attention in medical circles, and led to the trial of his method in practically every part of the civilized world. Modifications were, of course, made in the exact strength of the silver used, but in other respects the plan remained much as the originator had devised it. Excellent results were reported by Königstein, v. Hecker, and Bayer. In reference to the figures given by the last-named, during the years 1877 to 1880, ophthalmia at Stuttgart had ranged from 8.7 per cent. to 14.3 per cent. of the births, but with the adoption of the Credé method in 1881, not a single case of ophthalmia occurred among 351 newly-born children.

Credé's epoch-making experiences have been repeated, extended, and confirmed in every quarter of the world. Medical literature abounds with striking testimonies to the success of his plan. The three leading groups of figures were published by Otto Haab, of Zürich, in 1886, by R. Köstlin, of Halle, in 1895, and by Hermann Cohn, of Breslau, in 1896. Köstlin, in his well-known communication upon the value of Credé's method (*Archiv f. Gynäk.*, 1895, Bd. L, Heft 2, p. 257), showed that prior to the introduction of the plan in 1881, the amount of ophthalmia in thirty-eight returns from the practice of thirty-two observers ranged from 2.25 per cent. to 50 per cent., and averaged 9.24 per cent. After the adoption of the Credé plan, among 24,724 babies, ophthalmia varied from zero (Leopold, Bayer, Feis, Vinay, and Garrigues) to 1.93 per cent. (Felsenreich), and averaged 0.655 per cent. Testimony of a similar character was given by Haab in 1886. (*Corresp. Blatt f. schw. Aerzte*, 1886, XV, p. 7). That observer found that prior to the introduction of the Credé plan, there was 8.9 per cent. of ophthalmia among 42,871 births, and that after, 1 per cent. only among 10,521 babies. Hermann Cohn in his monograph, *Ueber Verbreitung und Verhütung der Augeneiterung der Neugeborenen*, published in the year 1896, quoted the same figures as those given earlier by Köstlin.

Many attempts have been made to replace silver nitrate by

other agents, antiseptic or not. The list is a long one and includes carbolic acid, sublimate, sterile water, lemon juice, iodoform, aniodol, citric acid, iodine trichloride, protargol, argyrol, silver acetate, and sophol, to name only a few of the number. The claims of these and of other agents, however, will be examined in detail later, and for the moment we may confine ourselves to the discussion of what is clearly the most important of the plans, namely, that introduced originally by Credé.

Although objections have been raised to anything like a general adoption of Credé's method, yet these have usually been of so vague and intangible a character that it is impossible to examine them seriously, let alone to refute them. On the other hand, of 110 medical men who replied to a circular letter on ophthalmia neonatorum issued by Cohn in 1896 (*loco citato*, p. 67), fifteen only were opposed to the general introduction of the method. Of the dissentients, one alone, Wilbrand, of Hamburg, was able to bring forward any definite objection in the shape of consecutive corneal opacities, or rather maceration. These two cases he had met with in the course of a single week (*loco citato*, p. 86). There was no blennorrhœa.

A few tangible objections to the Credé plan have been mentioned by various writers. They are four in number, *viz.* :—1. conjunctival catarrh; 2. conjunctival haemorrhage; 3. corneal opacities or ulcerations; and 4. miscellaneous objections. These allegations must be examined one by one.

1. Conjunctival Catarrh.

That the use of a 2 per cent. solution of silver nitrate, as recommended by Credé, is often, perhaps always, followed by a discharge from the eyes, and in rare instances by a certain amount of hypcaemia, is a fact that will be disputed by nobody who has had practical experience of the method. Credé himself, as already mentioned, was familiar with the point. H. Cramer (*Archiv. für Gynäk.*,* LIX, Heft I, 1899, p. 165) has, however, gone farther, and claimed that in a large number of instances

* In another communication (*Centralblatt für Gynäk.*, March 4, 1899) Cramer repeated his statements, and took the opportunity of saying that the question was one upon which the opinion of ophthalmic surgeons, as opposed to that of obstetricians, could carry little weight.

the silver salt sets up inflammation of the conjunctiva. He found an appreciable reaction, the so-called *Argentum-Katarrh* in no fewer than 96 of 100 consecutive cases at the Bonn Lying-in Institution. This, he thinks, is more closely connected with the presentation or the development of the baby than with the quantity of the solution employed, as supposed by Cohn.* It thus came about that the most violent reactions were seen in twins. In four babies the secretion was characterised by Cramer as "enormous"; in 25, as "very severe"; in 31, as "severe"; in 20, as "moderate"; in 10, as "slight"; in 6, as "very slight"; while in the remaining 4 babies no discharge was demonstrable. In 73 of Cramer's cases the secretion had ceased by the fifth day, and in 27 lasted longer than that period. This author's results are tabulated below:

Grade of Reaction.	Total Numbers.	Healed on day.					Later Healing.	Secondary Irritation.
		1	2	3	4	5		
No Secretion	4	4	—	—	—	—	—	—
Very Slight	6	3	2	1	—	—	—	—
Slight	10	—	6	3	—	—	—	1
Moderate	20	—	5	9	3	1	1	1
Severe	31	—	2	10	6	2	8	3
Very Severe	25	—	—	2	7	4	6	6
Enormous	4	—	—	1	2	—	1	—
Totals ...	100	7	15	26	18	7	16	11

It must, however, be pointed out that Cramer did not adhere strictly to Credé's method, but in order to secure a complete distribution of the 2 per cent. solution, opened and closed the baby's eyelids with his forefinger a number of times. In certain cases more than a single drop was purposely used. These facts render it certain that traumatism had much to do

*This is, of course, an altogether different thing from asserting that the reaction bears no relationship to the strength of the silver solution employed. Leopold (*Münch. med. Wochenschrift*, 1906, No. 18) has recently emphasised the fact that the reaction is slighter after the employment of 1 per cent. than of 2 per cent. silver.

with Cramer's bad results, which still await confirmation from other observers.

On the other hand, there is no lack of evidence directly opposed to Cramer's results. The most conclusive of these are contained in the communications of Leopold and of Bischoff, respectively.

G. Leopold (*Berl. klin. Wochenschr.*, 1902, No. 33) subjected Cramer's statements to a close and critical examination. He insisted (and with justice) that the *technique* employed by Cramer was certainly not the one described so accurately by Credé, and that it, and it alone, was responsible for the extraordinary results obtained. Among 30,000 babies treated according to the orthodox way, Leopold had never witnessed such severe and frequent reaction as that described by Cramer in his hundred cases.

Bischoff (*Centralbl. f. Gynäk.*, March 7, 1903, p. 293) published the following figures obtained from the Bonn Lying-in Institution, where, it will be remembered, Cramer's observations were also made :

Day.	REACTION.					=	100
	Strong.	Medium.	Little.	Minimal.	None.		
1	0	20	22	38	20	=	100
2	0	0	6	22	72	=	100
3	0	0	1	10	89	=	100
4	0	0	0	0	100	=	100

It will be noted from the figures given that a silver reaction was present in 80 per cent. of Bischoff's cases, but for the most part this was very slight. In 20 cases only could a "medium" reaction be observed, and never a "severe" one. In 38 cases the reaction was described as "minimal."

Now it is clear (as Leopold has remarked) that if the severe reactions described by Cramer do really follow the proper use of silver to the eyes of babies, then anything like a general introduction of Credé's method is not to be thought of. In order to ascertain the facts, careful observations, both clinical and bacteriological,

have been carried out at Queen Charlotte's Hospital, London, an institution to which I am attached in the capacity of ophthalmic surgeon. Three sets of observations have been made—the first in 1903, the second in 1906, and the third in 1907. The results were as follows: between January 5, 1903, and January 21, 1903, 50 consecutive babies were closely observed, and in all, except possibly one, there was some reaction after the use of the silver drops. This took the form of a watery mucous discharge from the eyes, not accompanied by any appreciable redness of the ocular or palpebral conjunctiva. In a few instances discharge from the eyes was noticed within an hour of the application, but usually it was not observed until three hours had elapsed. It persisted from four hours to $2\frac{1}{2}$ days. A bacteriological examination of the eyes that showed relatively much discharge, some twelve in number, disclosed in no instance the presence of a definitely pathogenic organism, and in a majority of the observations yielded negative results. Thus, in 7 cases no growth was obtained on the nutrient media employed, neither were micro-organisms identified in cover-slip preparations of the discharge, while in 5 others the xerosis bacillus, the bacillus cremoidies, the sarcina flava, the micrococcus sulphureus, and the staphylococcus albus (or the staphylococcus epidermidis albus) were present.

The results of the second set of observations, carried out at Queen Charlotte's Hospital in December, 1906, I give under reserve, inasmuch as the results do not altogether agree with what I have myself seen of the reaction that follows the use of silver drops. During December, 1906, the eyes of 160 babies were treated with a single drop of 1.6 per cent. solution of silver nitrate, and reaction, according to the notes, was observed in only 49 among the whole series. The 49 reactions (unequal in the two eyes in 4 instances only) were classed, according to degree, as follows: "very slight," 11, or 22.45 per cent.; "slight," 26, or 53.06 per cent.; "severe," 8, or 16.33 per cent.; and "very severe," 4, or 8.16 per cent. The discrepancy of these figures lies in the fact, as it seems to me, that in no fewer than 69.37 per cent. of the babies no reaction is stated to have followed the use of the drops. This error in observation could easily be made, since in most instances the evidences of reaction are so trivial that two equally

competent observers might differ as to whether reaction was or was not present in a given case. The other figures are probably correct.

The third set of observations were carefully carried out by Dr. Eardley Holland, resident medical officer, in February, 1907, and included 62 consecutive births. No reaction was noted in 14 cases, or 22.58 per cent.; slight reaction in 26 cases, or 41.93 per cent.; and severe reaction in 22 cases, or 35.48 per cent. The first group "no reaction," included cases where no discharge from the eye could be found, although the ocular conjunctiva might be temporarily reddened. The second group "slight reaction" meant that cases were unaccompanied by swelling of the eyelids, but associated with some discharge, which usually took the form of caked or dried secretion about the lids or at the corners of the eyes. The third group "severe reaction," implied a free discharge of muco-pus, together with appreciable swelling of the eyelids. In neither "slight" nor "severe" reactions did the discharge persist for longer than a few hours.

The silver solution used in the foregoing observations had a strength of eight grains to one ounce (1.6 per cent.), and a single drop of the liquid was applied in every instance.

P. Zweifel (*Centralbl. f. Gynäk.*, December 22, 1900) has recently conducted some experiments with the object of ascertaining the cause of the catarrh that is admitted to follow, in many instances, the employment of Credé's method. Zweifel did not believe, as many had done, that the reaction after silver was due to the use of too much solution, or to irritation of the eye by the glass rod employed and recommended by Credé, since in his own cases neither cause was met with. Other factors, he thought, must be at work. In 816 newly-born babies Zweifel washed one eye with distilled water before applying the silver, while, after the silver had been used, he irrigated the other eye with a dilute solution of common salt. Under these circumstances he found that catarrh developed in the first but not in the second eye. Zweifel therefore thinks that catarrh may be due to the absence of saline tears from the newly-born child, and, logically enough upon that view, advises that the silver employed in the Credé method be afterwards neutralised by means of a solution of salt. He claims, finally,

that neutralisation with sodium chloride does not impair the protective influence of the silver, and, in support of that statement, points to the fact that among the babies so treated, two alone (0·245 per cent.) developed ophthalmia, the mothers suffering at the same time from gonorrhœa.

The question may, I think, be fairly summed up by saying that a trivial reaction, as shown by discharge from the conjunctiva, usually follows even the most correct employment of Credé's method. At the same time, the extraordinary results published by Cramer have not been seen in the practice of other observers. There is no evidence to prove that the application can cause an actual inflammation of the conjunctiva. At most, it may possibly predispose to such inflammation by reducing the resisting powers of the parts, so that common micro-organisms, usually non-pathogenic as regards the conjunctiva, may assume more or less infective powers. This result, however, is rare. The truth of this view is borne out by the undoubted fact that in many mild catarrhs of newly-born babies where silver has been used, nothing can be found in the conjunctival secretion, despite careful search on cover-glass preparations and cultures on various media, except the *staphylococcus albus* and the ubiquitous *xerosis bacillus*, which by many authorities are believed to be normal, or almost normal, denizens of healthy conjunctivæ. In regard to the innocuous action of silver, a striking statement by H. J. Garrigues (*Amer. Journ. of the Medical Sciences*, October, 1884) may be quoted : " How little the eyes are affected by the silver solution is best shown by cases in which, through carelessness, so much of the solution was introduced that the eyes became surrounded by black rings."

2. Conjunctival Hæmorrhage.

It is a rather curious circumstance that several cases have been reported where persistent bleeding from the conjunctiva has followed the use of silver drops. In de Schweinitz's case (*Medical Record*, April 18, 1891) a 2 per cent., and three hours later a 4 per cent., silver solution, was applied to the eyes. Twelve hours afterwards, bleeding from the conjunctiva set in and persisted for about two days. The baby, one of colour,

eventually recovered. Oscar Müller (*Arch. f. Gynäk.*, Bd. XLIV, 1893, p. 269) observed capillary bleeding from the conjunctiva fatal four days after a drop of a 1 per cent. solution of silver nitrate had been applied to the eyes of a baby girl, twice at an interval of twelve hours. Müller regarded his case as an example of haemophilia, although there was no history of heredity and the patient was a female. A. J. Abbe (*Annals of Ophthalmology*, 1899, p. 10) had a case in a baby born at term but weighing only five pounds. Some twelve hours after birth, owing to the existence of discharge from one eye, a drop of a 6 per cent. solution of silver nitrate was used, but (to quote the author's own words) "before this was done, the lid of the right eye had begun to look red and swollen." Shortly after the application, blood commenced to trickle from one eye, and this was soon followed by bleeding from the other eye. In spite of treatment, the baby died about two days after the haemorrhage was first noticed. A case that ended in recovery has recently been reported by A. A. Hubbell (*American Journal of Ophthalmology*, January, 1906). Owing to a misunderstanding on the part of a nurse, a 2 per cent. solution of silver nitrate was applied every four hours to the eyes of a newly-born baby. Within 24 hours, symptoms, believed to be then of ophthalmia, developed, and at the end of thirty-six hours both eyes began to bleed. Dressing after dressing became saturated with blood. But under the continuous application of iced cloths, bleeding ceased in twelve hours.

With regard to the four cases mentioned above, it is clear that, strictly speaking, in none can the bleeding be charged to the account of the Credé method, in which a single drop of a 2 per cent. solution of silver is to be applied.

In a case reported by O. D. Pomeroy (*Medical Record*, August 20, 1887), however, Credé's method appears to have been adopted one day after birth. It was followed by a slow oozing of blood from the conjunctiva. The baby did not die, although at one time it seemed likely he would do so. A more recent case is that of M. Wiener (*Amer. Journ. of Ophthalmology*, March, 1903). Two drops of a 2 per cent. solution of silver nitrate were instilled into each eye of a baby immediately after birth, a prophylactic step rendered necessary because the mother

was suffering from gonorrhœa and chancroids. On the following morning the infant's eyelids, face, and pillow were found to be covered with blood. The bleeding had been first noticed one hour after birth. When Wiener saw the infant about ten hours after birth, he found the palpebral conjunctiva coated with a white membrane, apparently due to a slough of the epithelial layer. Despite treatment by adrenaline, stick alum, gelatine, and the rectal injection of normal saline, the infant died six days after birth. It is a little unfortunate that nothing is said by Wiener as to the presence or absence of syphilis.

In this connection it may be noted that bleeding from the conjunctiva has been seen on several occasions in babies suffering or convalescent from ophthalmia neonatorum. James Ware (*Remarks on the Ophthalmia, Psorophthalmy, and Purulent Eyes of New-born Children*, second edition, 1814, p. 315) gave details of such a case where a baby, when about a week old, was seized with ophthalmia, attended with a great discharge of matter. After three days, instead of pus, pure blood continually issued out. Haemorrhage ceased under treatment with diluted aqua camphorata, and the child, after a relapse, eventually made a good recovery. Another English writer, Edward Hocken (*London Medical Gazette*, 1840, p. 837), met with a case in an infant affected with purulent ophthalmia, in which blood slowly trickled from between the lids, mixed with the discharge. J. A. Shirley (*New York Medical Journal*, January 2, 1892) described a fatal case in a mulatto girl, affected with congenital syphilis. In order to subdue an attack of ophthalmia, which supervened about six weeks after birth, the palpebral conjunctiva was freely scarified, and then treated with sulphate of copper. A few hours later, bleeding set in from the conjunctival incisions, and continued in "a free, continuous, steady stream," until the baby's death. Nettleship (*Diseases of the Eye*, 1897, p. 83) spoke of having seen a similar condition in a child recovering from purulent ophthalmia. Etlinger (*Michel's Jahresbericht*, 1900, p. 498) observed bleeding from the conjunctiva of one upper lid during the course of ophthalmia in a newly-born child, delivered somewhat before term. The haemorrhage, after lasting five days, terminated in death. There was also jaundice, suppuration of the navel, petechiæ, and pulmonary symptoms, so that the case appears to have been one of sepsis. H. F. Hansell (*Ophthalmic Record*,

February, 1901) described a case in a seven months' negro baby, weighing 3 lbs. 3½ ozs. E. H. Oppenheimer (*Ophthal. Record*, April, 1906) had a case in a baby one day old.

The question must, indeed, be asked whether there is any causal connection between the use of silver drops, on the one hand, and conjunctival bleeding, on the other. Newly-born babies, it must be remembered, are predisposed to haemorrhage by reason of the profound changes that take place at birth, both in the composition of the blood and the mechanism of the circulation. Instances of traumatic haemorrhage, as sterno-mastoid ecchymosis, intra-cranial haemorrhage, cephalhaematoma, and visceral bleedings, resulting from injuries or conditions inherent upon birth, are, of course, well known to every obstetrician. Apart from definite anatomical lesions, there exists in certain babies a tendency to spontaneous bleeding. This so-called "idiopathic haemorrhage," or "haemorrhagic disease of the newly-born," although rare, is perfectly familiar to all who have to do with very young children. The disease, which appears to be distinct from haemophilia, is associated in some instances with congenital syphilis, and in many more with general sepsis. Its frequency has been estimated at from 0·6 per cent. (Townsend) to 1·4 per cent. (Ritter). Gaertner (*Archiv für Kinderheilkunde*, 1895) found in the blood from two cases of this curious affection a colon-like bacillus, which produced a haemorrhagic disease when injected into the peritoneum of puppies. Some recent work points with tolerable likelihood to Gaertner's bacillus as being actually the cause of the disease.

Apart from causation, the condition is characterised by bleeding from any mucous membrane, as that of the nose, mouth, lips, pharynx, stomach, bowel, genitals, ears, or eye, or by more or less extensive haemorrhage from the umbilicus, beneath the skin, or into the serous cavities of the body. It is to be noted as a point of some little interest that haemorrhage from genital organs, ears, mouth, and eyes is often preceded by slight local inflammation. The disease is most common in the first week of life. Death has been estimated to occur in at least 60 per cent. of the cases.

Here, then, is a disease stated on good authority to occur in from 0·6 per cent. to 1·4 per cent. of the babies born in lying-in institutions—that is to say, in the very places where Credé's

method is most likely to be practised. The silver treatment has now been carried out in many thousands of births, among which it is not to be wondered at that a certain small proportion of instances of haemorrhagic disease has occurred. This could not well be otherwise, since nobody has yet claimed that the Credé plan will prevent this mysterious affection of newly-born children! The mere fact that the bleeding often occurs from parts of the body other than the conjunctiva, proves very conclusively that the process is in no sense a simple local one.

We know, moreover, that idiopathic haemorrhage may take place altogether apart from the use of silver drops or other applications to the eyes. For example, in Ritter's list of 190 cases among 13,000 births in Prague (*Oesterreiches Jahrbuch für Pädiatrik*, 1871) haemorrhage was noted from the conjunctiva in 20 instances. Koudiche (*Rev. gén. d'ophtalmologie*, 1898, p. 35) reported a fatal case in a baby, one day old, where silver had not been used, and Oetlinger (ref. in *Annals of Ophthalmology*, 1901, p. 153) another in an infant where bleeding from the conjunctiva and beneath the skin led to death in six days.

In brief, it seems likely that the association in rare cases of bleeding from the conjunctiva and the previous use of Credé's method is more or less in the nature of a coincidence. As Wiener, in reporting his fatal case, said: "to my mind, the silver nitrate was the occasion, but the cause was undoubtedly a predisposition of the child to bleed." On the evidence before us it may be admitted, at the outside, that the use of the silver determined one site of the haemorrhage, although by no possibility could it, in my opinion, be held responsible for the cause of the bleeding itself. A similar remark applies also to the haemorrhage sometimes seen from the eye in cases of ophthalmia neonatorum, where silver nitrate may or may not have been employed.

3. Corneal Opacities or Ulcerations.

Although it has been alleged that corneal opacities may follow the use of the Credé method, yet few, if any, of the recorded observations with regard to this point will bear the least critical examination. Wilbrand's two cases have been mentioned before (page 165), but in neither could it be ascertained, despite Cohn's careful enquiry into the facts, (*a*) how the method was carried out; (*b*) the strength of the solution employed; and (*c*) the number of

drops that had been applied to the eye. In one case, indeed, the statement, that "drops had been poured into the eyes," rested on the mother's word alone! I must leave my readers to judge what amount of credence should be attached to loose assertions of this kind.

Van den Bergh (*Presse médicale belge*, October 13, 1895) has reported a case which is sometimes quoted as an example of the bad results entailed by the Credé method. Here are the facts: a baby, premature, pitiful, and weakly, was delivered by forceps after a tedious labour. The lids of one eye were swollen and bore the imprint of the forceps' blade. The father, a medical man, doused out the conjunctival sac with a strong solution of sublimate, 1 : 1,000, immediately after birth. Some hours afterwards, fearing that ophthalmia might develop in the eye marked by the forceps, he everted the lids of that eye and brushed a 2 per cent. solution of silver nitrate over the palpebral conjunctiva. This energetic application was followed within 24 hours by a fibrinous conjunctivitis and an opacity of the cornea. Micro-organisms could not be found in the conjunctival membrane. In reference to this case it need only be remarked that Credé never recommended so drastic a measure of prevention as was adopted by the father of this unfortunate baby!

Romiée (*Le Scalpel*, February 2, 1896) quoted cases where a fibrinous conjunctivitis and corneal opacities are said to have followed the employment of the Credé plan. His statements, however, are open to a similar kind of criticism, a remark that applies equally to the cases mentioned by Ludwig Hirsch (*Klinisches Jahrbuch*, Bd. VII., 1902, p. 517) as having occurred in the practice of Uhthoff and of Elschnig respectively.*

Against these inconclusive, and indeed misleading, statements we may put the fact that amongst 30,000 babies treated by Credé's method by W. Leopold (*Berl. klin. Wochenschr.*, 1902, No. 33) no damage to the cornea had ever been observed, while the same remark applies also to the 24,723 babies tabulated by R. Köstlin (*Archiv für Gynäkologie*, Bd. L, Heft 2, p. 257, 1895). The latter author, despite his extensive researches, had never been able to find an authentic case where damage to the

*F. Ahlfeld (*Lehrbuch der Geburtshilfe*, 2nd edition, 1898, p. 608) briefly mentions an opacity of the cornea following the use of Credé's method. Gonococci could not be found, despite repeated examinations of the discharge from the eye.

cornea had followed the use of the Credé plan (*loco citato*, page 275). At Queen Charlotte's Hospital, London, no affection of the cornea has been observed amongst the babies, upwards of twelve thousand in number, treated prophylactically with silver nitrate.

In the discussion on ophthalmia neonatorum at the Obstetrical Society of London in July, 1903, which the writer had the privilege of opening, not a single speaker instance a bad result as following the employment of the Credé plan (*British Medical Journal*, July 18, 1903, p. 135). The speakers included obstetricians, ophthalmic surgeons, and bacteriologists.

Moreover, it may be taken for certain, as Lueien Howe has shrewdly pointed out (*Amer. Journ. of Ophthalmology*, 1897, p. 228), that if a bad result could be traced to the Credé method, the fact would be accorded a wide publicity. Neither should it be forgotten that severe corneal ulceration has been known to follow the use of distilled water to a baby's eyes by Hofmeier (*Münch. med. Wochenschr.*, 1890). Hofmeier's case, however, I suspect to have been one of keratomalacia.

4. Miscellaneous Objections.

To anything approaching the general adoption of the Credé method a few other objections have been raised. One has been that the plan is too complicated to be entrusted to the average midwife. The objection might be well-founded if the eyelids had to be everted before the silver could be applied, as taught by Graefe, Horner, Gayet, and some others. That little manœuvre, indeed, in a newly-born baby, is often difficult enough to tax even a practised hand. It is now, however, generally recognized that nothing of the kind is necessary, or even desirable.

The statement that the Credé method cannot safely be left to midwives may have been true once to some extent, but in England at the present time it can hardly apply. The requirements of the Central Midwives Board has led, and will lead, to a general levelling up of the women engaged in attending labours among the poor population, both in town and country. Even if that were not the case, and the midwife were too unintelligent to apply the plan correctly, as assumed by Kielmann, Haussmann, Schirmer, Zehender, and Valenta, that could scarcely be admitted as a serious argument against the desirability of adopting the Credé method, although it might be against its practicability.

A midwife, when all is said and done, is often compelled to undertake things that call for at least as much intelligence as applying a drop of liquid to a baby's eyes, such as giving a vaginal douche or an enema, rupturing the membranes, tying the umbilical cord, passing a catheter, or even administering a hypodermic injection, say, of ergot. In Prussia, indeed, according to Leopold, midwives are permitted to perform version; while in Sweden, according to Fuchs, they are even allowed to apply the forceps! In France many more or less complicated operations fall to their lot. Zweifel (*Centralbl. für Gynäk.*, 1900) goes so far as to say, in reference to this question, that most midwives can apply the silver drops just as well and as carefully as many medical practitioners, and I am inclined to agree with him from what I know of both classes.

Miehaelson's case (*Centralbl. f. prak. Augenheilk.*, 1900, p. 63), where a midwife, having run out of the 2 per cent. solution, hastily sent to the nearest chemist and obtained a solution of 20 per cent. silver, which she dropped into the eyes of two babies, with consequences that may be better imagined than described, must surely constitute an almost unique instance of carelessness on the part of the chemist. It is, however, no argument against Credé's method, as some writers have appeared to think. Klotz (*Centralbl. für Gynäk.*, October 4, 1902) once saw a severe cauterisation of the cornea follow the use of a 20 per cent. solution, dispensed by the chemist in mistake for a 2 per cent. solution. Such mishaps, therefore, may happen to the medical man as well as to the midwife, and as little blame is to be attributed in the one case as in the other.

Haab (*Correspondenz-Blatt für schweizer Aerzte*, January 15, 1885) did not mince matters when he suggested that a nurse who was incompetent to apply the silver drops should be compelled to change her avocation!

A rational standpoint was adopted by Königstein (*Wiener med. Presse*, 1883, No. 38), who advised that the Credé method should be entrusted to those midwives only who had been shown how to apply the drops properly. With this sentiment everybody will be in accord!

Ernst (*Centralbl. für Gynäk.*, October 15, 1904) related a case where severe reaction followed the application by a nurse of a solution of silver nitrate which had become concentrated by

evaporation. On that account he advised (rightly enough) that care should be exercised in keeping the solutions.

The following is the sort of statement one now and then comes across, the object of which is clearly to discredit the results obtained by the Credé method. This particular example occurs in an article by Hirsch, abstracted in the *Centralblatt für Gynäkologie* for October 15, 1904, and runs as follows:—"of 92 babies treated by Schmidt-Rimpler at the Halle Klinik for ophthalmia neonatorum, 34, or 37 per cent., according to the mothers' statements, had had the Credé method applied at birth." Now what does this mean, if it means anything at all? To begin with, the statement that the Credé plan had been adopted rested solely upon the mothers' assertions, a fact that, in my opinion, in itself goes far towards invalidating the conclusion that the author obviously desires his readers to draw. The question at issue here is not so much whether the method was used properly, but rather whether it was used at all. Then, even by enthusiasts it has never been claimed, so far as I know, that the most correct application of the plan is able in every instance to prevent ophthalmia. Hence, Hirsch's statement, as it seems to me, may be brushed aside as both misleading and unscientific, unless that author can furnish us with figures showing what number of babies had been treated, how they had been treated, and what was the percentage-incidence of ophthalmia among the entire number. Yet this is precisely the kind of loose statement upon which we are sometimes expected to condemn Credé's accurate and scientific observations.

It is impossible to pass over in silence, although one would willingly do so, the curious views expressed by Dudley S. Reynolds (*Journ. Amer. Med. Association*, January 6, 1900) with regard to the Credé method. His exact words were as follows: "It is always the result of contagion, very rarely, if ever, occurring in the process of delivery, the infecting agent being introduced either at the time of attempting to practice (*sic!*) the Credé method, or some similar mode of prevention, or by unskilled handling of the eyes of the infant by the nurse." "The irrational method of Credé," he continues, "and others who have advocated the use of a 2 per cent. solution of nitrate of silver or similarly strong solutions of

bichloride of mercury, formalin, etc., cannot be too strongly condemned, as they cannot prevent the ordinary sources of infections, and a single application could not destroy the infection after it had been introduced. The irritation it produces leads to subsequent handling of the eyes, and multiplies the chances of infection." Comment seems to be needless on this naïve display of downright ignorance.

Let us endeavour to be fair in the matter. With all the evidence before us, we are compelled to admit that Credé's method is most efficient in preventing ophthalmia. I shall show, a few pages farther on, that among 76,452 babies in whom the 2 per cent. silver has been applied, the morbidity of ophthalmia amounted to 0.703 per cent. only. At the same time, we must also admit that it is usually attended with a conjunctival reaction that, although trivial as a rule, may on occasion exceed the result that is either desired or expected. In view of the contingent benefit of the plan, one was compelled to put up with this drawback in the days when the aseptic management of the puerperal woman and her offspring was as yet in its infancy. It is another question whether nowadays, under widely different conditions, the desired result as regards the baby's eyes may not be secured by means as efficient but less rigorous. Personally, at all events, as I hope to be able to show later, I believe that this *desideratum* now lies well within our grasp.

It is obvious that much depends upon the care with which the silver drops are applied to the eyes, a point upon which G. Leopold (*Berliner klin. Wochenschr.*, 1902, No. 33) has laid particular emphasis. He tells us that sometimes an entire year passed at the Dresden Klinik without a single case of ophthalmia, although the precautions remained the same, and no fewer gonorrhœal women were confined. Leopold's explanation was that the obstetric wards were in the hands of assistants and midwives who were especially careful. Under other circumstances, cases of ophthalmia occurred, but careful investigation never failed to bring the cause to light, in the shape of a careless *personnelle*, medical or otherwise. It might be claimed, in fact, without stretching the point unduly, that almost as much depends upon the way the plan is carried out as upon the plan itself.

It has been just remarked that Credé's method does not always prevent the development of ophthalmia. A moment's

consideration of the causes of the malady will show that this must naturally be the case. In the first place, ante-partum infections, which I have shown to be commoner than generally believed, cannot be influenced by a drop of silver applied to the baby's eye immediately after birth. Secondly, as we have seen, every case of ophthalmia is not due to the gonococcus, against which organism alone silver nitrate is specific. Hence, infection with some other microbe, such as the pneumococcus or the colon bacillus, even although conveyed during the act of birth, may not be destroyed by the silver drops. Thirdly, late infections (B), which, according to the estimates of various authors, account for from 10 per cent. to 32 per cent. of all cases of ophthalmia neonatorum, cannot be prevented by the Credé method. The conclusion is therefore inevitable that no matter how correctly the silver be used, the method cannot always succeed in preventing the development of ophthalmia.

At the same time figures exist to show that silver is almost a specific when gonorrhœa is known to be present in the mother. Those furnished by that careful observer Zweifel (*Centralbl. f. Gynäk.*, 1900, p. 1,375) may be quoted in proof of this statement. Among 816 babies treated by the Credé plan, two alone developed ophthalmia, notwithstanding the fact that 61 of the mothers were known to be affected with gonorrhœa. Again, according to the figures given by Schallehn and Runge from Göttingen, among 1,197 babies treated between the years 1888 and 1902 with 2 per cent. silver, not a single case of early infection and only two late infections were observed. Yet, on occasions, as many as 20 per cent. of the mothers were known to be suffering from gonorrhœa.

Admitting, then, that the most careful use of the Credé method cannot prevent either ante-partum or late infections (B) and, possibly, infections dependent upon organisms other than the gonococcus, there still remains the fundamental fact—namely, that among the 24,723 babies included in Köstlin's lists, where the plan had been adopted, only 0.655 per cent. developed ophthalmia. In order to realise what this means, we have merely to contrast with that figure 17,767 births reported by twelve observers prior to the introduction of the Credé method, with 9.24 per cent. of ophthalmia among the infants. In other

words, where fifteen cases once occurred, one case only is now met with, and yet it is still urged in some quarters that the Credé plan is inefficient !

The following figures dealing with 51,728 babies treated by Credé's plan have been collected since the year 1895, when Köstlin published his communication in the *Archiv für Gynäkologie* (Bd. L, Heft 2, p. 257). They are conclusive as to the value of the method, by the adoption of which they show that the morbidity of ophthalmia can be brought well under 1 per cent :

A Table showing the frequency of Ophthalmia neonatorum after the use of the Credé method.

Name.	Births.	Oph-thalmia.	Reference.
Bröse	2,107	2·51	<i>Zeitschr. f. Gebürt. u. Gynäk.</i> , Bd. X, 1884.
Andrews	83	—	<i>New York Medical Journal</i> , 1885, p. 481.
Widmark	1,153	0·53	<i>Rev. générale d'ophtalmologie</i> , Apl. 30, 1888.
Haab	10,521	1·0	<i>Corresp.—Blatt f. schw. Aerzte.</i> , 1886, xv., p. 7.
Tarnier	218	5·9	<i>Annales d'oculistique</i> , August, 1891, p. 100.
Sloane Maternity ...	4,000	—*	<i>Medical Record</i> , Feb. 16, 1895.
Schallehn	917	—	<i>Arch. f. Gynäk.</i> , Bd. 54, Heft 1.
Mermann	200	0·5	<i>Oftal. purulenta de los Recién Nacidos</i> , by Alvarado, 1904.
Schmitt	962	3·6	<i>Ibidem.</i>
Korn	1,600	—	<i>Ibidem.</i>
Hôpital S. André, Bordeaux	174	—	Durand.— <i>Thèse de Bordeaux</i> , 1885.
Maternité, Bordeaux	514	0·05	Ibid.— <i>Ibidem.</i>
S. Roche, Budapest...	8,343	0·143	<i>Oftal. pur. de los Recién Nacidos</i> , by Alvarado, 1904.
Runge	1,000	—	<i>Berl. klin. Wochenschr.</i> May 19, 1902.
Leopold	2,146	0·14	<i>Berl. klin. Wochenschr.</i> , 1902, No. 33.
Ibid.	698	—	<i>Ibidem.</i>
Kreutzkamp	4,528	0·2	Ref. in <i>Centralb. f. Gynäk.</i> , March 18, 1905, p. 337.

* The report stated: "No case of any account."

Name.	Births.	Oph-thalmia.	Reference.
Cartburg	2,304	0·17	<i>Inaug. Dissertation, Greifswald, 1903.</i>
Fehling } Bumm }	4,528	0·2	Ref. in <i>Münch. med. Wochenschr.</i> , February 16, 1904, p. 297.
Rotunda Hospital, Dublin	5,158	0·15	<i>Clinical Reports of the Rotunda Hospital, 1905 and 1906</i> , supplemented by private communication from Dr. E. Hastings Tweedy, Master.
Glasgow Maternity Hospital, 1906	574	0·69	Private communication from Dr. Robert Jardine, Senior Physician to the Hospital.
Totals	51,728	0·751	

If we now add the figures collected by Köstlin, prior to the year 1895, to those collected by me since that date, the results come out as follows:—

A Table showing the percentage of Ophthalmia among 76,452 babies treated according to the Credé plan.

	Births.	Percentage with Ophthalmia.
Köstlin's collective figures (25 returns)	24,724	0·655
Personal (21 returns)	51,728	0·751
Totals	76,452	0·703

Leopold's words (*Berl. klin. Wochenschr.*, 1902, No. 33) bring graphically before the mind the state of things that existed in the maternity hospitals before Credé wrote his famous articles. This is what Leopold said: "At the end of the seventies there was probably no obstetric klinik that did not, in a room apart, show one or several of these unfortunate infants, who were in danger of being blinded for life. It made one shudder to enter such an apartment. Yet but a few years later, beginning with 1884, this room had vanished as if by magic from the obstetrical kliniks . . . Every klinik that desired to obtain such excellent results made use of the 2 per

cent. silver solution and the small glass rod, two things that are as simple as could possibly be desired."

In the light of the figures just quoted it may be doubted if the annals of preventive medicine include a single chapter whose contents are so wholly satisfactory as that describing the prevention of ophthalmia by the adoption of the Credé method.

When should the silver drop be put into the eye? Credé, it will be remembered, applied the medicament after the cord had been cut, and the eyes cleansed with ordinary water (*Archiv f. Gynäkologie*, Bd. XXI, 1883, p. 179). In any event, as he expressly pointed out, the instillation need not be undertaken before the cord was cut. But in private work, where help might not be readily available, Credé advised that the liquid be dropped into the eyes as soon as the cord was divided. The placenta was next to be looked after; and, lastly, the infant was to be bathed. Camillo Furst (*Centralbl. f. Gynäk.*, August 25, 1883) took, however, a different view, which he supported by quoting certain figures to show that better results were obtained if the silver were applied before, and not after, the cord had been severed. Experiments conducted at the Vienna *Gebäranstalt* under similar conditions amongst about 10,000 newly-born babies showed that the morbidity of ophthalmia was almost twice as great when the 2 per cent. silver was used after as when it was used before the cord was cut. Nevertheless, at Queen Charlotte's Hospital, London, where ophthalmia has been reduced almost to vanishing point (see p. 187), the drops are applied to the baby's eyes after the first bath—that is to say, some time after the cord has been divided.

Several years ago a suggestion was made by G. E. Abbott (*Medical Record*, September 21, 1889) which has not received the attention that it appears to me to deserve. Pending attention to the cord and removal of the placenta, Abbott, after cleansing the baby's face with a damp, aseptic napkin, covered the eyes with a narrow bandage (2 inches wide and 3 feet long) and secured it by means of a safety-pin. In this way it is rendered impossible for the infant to inoculate his eyes during the time devoted to the ordinary attentions of the bedside.

With the idea of reducing the reaction that so frequently follows the adoption of Credé's plan, several obstetricians have

employed solutions of lunar caustic weaker than the 2 per cent. originally recommended by the Leipzig professor. Thus, 1·6 per cent., 1·5 per cent., 1 per cent., 0·6 per cent., and even more attenuated solutions, have been used by various medical practitioners.

v. Hecker (*Arch. f. Gynäk.*, Bd. XX, Heft 3, p. 378) used a 1 per cent. solution and reported 3 per cent. of ophthalmia among 133 births, while Schmitt and v. Weckbecker-Sternfeld (ref. in *Centralb. f. Gynäk.*, November 10, 1883), with a similar concentration, had 1·844 per cent. of ophthalmia in 1,090 births. J. A. Andrews (*New York Medical Journ.*, 1885, p. 481) stated that of 58 babies treated at the New York Maternity Hospital with 1 per cent. silver, slight ophthalmia developed in ten or twelve, but in one instance alone was the cornea affected. A 1 in 75 solution of silver, according to N. Charles (*Journ. d'Accouch.*, 1888, No. 3), was employed at the Liège Maternity to the eyes of 377 babies, of whom one only developed ophthalmia. F. Buscarlet (*Archives de Tocologie*, 1889, July, p. 492) used a 1 per cent., or even a 1:150, solution immediately after accouchement, and generally found the last-named to suffice. He gave, however, no figures. Audebert (*Ibidem*, p. 512) used a 1 per cent. solution. C. A. Vcasey (*Medical and Surgical Reporter*, July 2, 1892) employed a 1 per cent. solution, of which he placed a couple of drops in each of the baby's eyes. According to May's figures (*Medical Record*, February 16, 1895) among 563 births from July, 1891, to November, 1894, at the Nursery and Child's Hospital, New York, a 1 per cent. solution was employed and one case of ophthalmia met with. Gusserow (*Centralbl. f. Gynäk.*, December 5, 1896) had used for many years a 1 per cent. solution of silver with good results. Irritation seldom followed the application. From a communication by Norton L. Wilson (*Philadelphia Medical Journ.*, February 11, 1899) one gathers that at the Sloane Maternity Hospital, New York, a 1 per cent. solution of silver is used instead of the 2 per cent. employed at most of the remaining institutions in the United States.

Champetier de Ribes (*Ann. de Gynéc. et d'Obstét.*, January, 1902, p. 13) used at first a 2 per cent. and later a 1 per cent. solution of silver nitrate, followed or not, as the case might be,

with a permanganate wash, and during the three years 1896-1898, among 3,021 accouchements, met with 34 cases of ophthalmia—1.12 per cent. The annual percentages were, 1.68, 0.72, and 1.01. Lepage (*Ann. de Gynéc. et d'Obstét.*, January, 1902, p. 14) used the 0.6 per cent. solution from May, 1901, to May, 1903, in 1,331 confinements, and had 10 cases of ophthalmia—two before and eight after the fourth day, or 0.15 per cent. primary and 0.60 per cent. secondary infections. Platon (Queirel's *Leçons de Clinique Obstétricale*, Paris, 1902, p. 286), by using the 1 per cent. solution, did not have a single case of ophthalmia in the 183 babies born during the year 1900 at the Marseilles Obstetrical Clinique. Ernst Runge (*Berl. klin. Wochenschr.*, May 19, 1902, p. 20), at Göttingen, among 928 infants and with 1 per cent. solution had no early infection and one instance only (0.108 per cent.) of late infection. On the other hand, with a 2 per cent. solution, the same observer among 1,000 babies met with no early infections and one late infection (0.1 per cent.). Runge laid stress upon the fact that silver reaction was almost absent from his cases, and expressed the opinion that a 1 per cent. solution was adequate for purposes of protection. G. Leopold (*Berl. klin. Wochenschr.*, 1902, No. 33) used 1.5 per cent. silver to the eyes of 191 infants, without meeting with a case of ophthalmia; and with a 1 per cent. solution in 698 infants had no early and a single late infection only. In Hofmeier's klinik (ref. in *Medical News*, September 23, 1905) with a 1 per cent solution, among 5,000 births, the morbidity of ophthalmia was reduced to 0.33 per cent., without the production of any silver catarrh worthy the name.

Dauber (*Münch. med. Wochenschr.*, February 16, 1904, p. 297) used the 1 per cent. solution to 160 babies without meeting with ophthalmia. A reaction was noted in 2.5 per cent. of the cases.

Ernst (*Centralbl. f. Gynäk.*, October 15, 1904) experimented some years ago with a 1.5 per cent. solution, and found that a certain degree of reaction followed its use. It was employed, however, to the eyes of 900 babies without any ophthalmia being entered upon the notes. Ernst then decided to try the 1 per cent. solution, which he declared always to be well tolerated and non-irritant as regards the conjunctiva. From January 1, 1902, to July 1, 1904, he treated with that liquid the

eyes of 1,111 babies at the Cologne Maternity without the appearance of a single case of ophthalmia.

Leopold has recently (*Münch. med. Wochenschr.*, May 1, 1906) reiterated his conviction that a 1 per cent. solution of silver nitrate is a simple, certain, and harmless means of preventing ophthalmia neonatorum.

An even weaker solution was adopted by Budin,* namely, 1:150 or 0.6 per cent. (*Le Progrès Médical*, January 19, 1895, and *Arch. de Tocologie et de Gynéc.*, May, 1895, p. 361). During a period of about four years (1891-94) at the Bordeaux Charité, 2,004 babies were treated with the solution. In the result two alone developed primary and seven secondary ophthalmia. Budin maintained that so harmless a liquid, which he regarded as efficient as it was non-irritating, might without danger be entrusted to the ordinary midwife, a view also adopted by Thoyer-Royat (*Soc. Obstét. de France*, April, 1901). The returns given by P. Sevray (*Thèse de Paris*, 1902) were on a larger scale. At the Maternity of the Saint-Antoine Hospital in Paris, between May, 1897, and June, 1901, 4,917 term infants were born alive. They were treated with Budin's solution. Of the 60 cases of ophthalmia, 24 (40 per cent.) were primary and 36 (60 per cent.) secondary. Among the total number (1.22 per cent.) were many very slight cases, which recovered in from three to five days. Maygrier has also employed the 1 per cent. solution with satisfactory results.

Rivière (*Arch. de Tocologie*, November, 1892) used a solution of silver as weak as 1:400 (0.25 per cent.), with which he treated the eyes of 403 babies, and had among them two cases of ophthalmia, or 0.49 per cent. One of Rivière's cases appeared, however, on the tenth day, so that in reality the proportion should be 0.24 per cent. In his private work the same author had no ophthalmia. A. T. Muzzy, writing in 1890

*Budin, in an earlier communication (*Journ. de Méd. de Bordeaux*, 1892, No. 43, p. 481), gave the following figures with regard to the use of the 1:150 silver nitrate: From October 1, 1891, to July 12, 1892, the eyes of 675 babies were treated with the solution, with the result that one premature infant developed membranous ophthalmia after the fifth day, while two others suffered from trivial conjunctivitis. He had, accordingly, one case of ophthalmia among 675 babies. The drops (*Arch. de Tocologie*, November, 1892, p. 877 *et seq.*) were applied immediately after birth, before the cord was cut, while the infant lay between the mother's thighs.

(*Amer. Journ. of Obstet.*, XXIII, p. 300), expressed the opinion, when discussing Crede's method, that silver would be found to be equally efficacious if only $\frac{1}{2}$ per cent. were used.

Greeff (*Berl. klin. Wochenschr.*, 1901, Nos. 4 and 5) recommended in the prophylaxis such weak solutions of silver as $\frac{1}{10}$ per cent. to $\frac{1}{4}$ per cent.

At Queen Charlotte's Hospital, London, a 1 per cent. solution of silver was employed during the five years, 1896-1900, to the eyes of 5,506 babies, and 25 cases of gonorrhœal ophthalmia, or 0.454 per cent., were registered. The annual proportion ranged from 1.31 per cent. in 1896 to 0.09 per cent. in 1900. The fact is probably not devoid of significance that the highest figure was recorded in the first year, and the lowest in the last year, inasmuch as experience of a given method has obviously much to do with success. In 1901, when a 1.6 per cent. solution was substituted for the 1 per cent. solution, a single case of gonorrhœal ophthalmia, or 0.083 per cent., occurred amongst 1,197 births. The percentage for the following years was as follows:—1902 0.66 per cent. ; 1903, 0.15 per cent. ; 1904, 0.29 per cent. ; 1905, 0.06 per cent. ; and 1906, 0.06 per cent.

A Table contrasting the results obtained at Queen Charlotte's Hospital, London, by the use respectively of a 1 per cent. and of a 1.6 per cent. solution of silver nitrate.

Queen Charlotte's Hospital.
(1896—1906.)

Period.		Strength of Silver.	Number of Births.	Percentage of Gonococcal Ophthalmia.
1896-1900	...	1 per cent.	5,506	0.454
1901-1906	.	1.6 per cent.	6,941	0.230
Totals	...	...	12,447	0.342

Tada Urata (*Zeitschrift für Augenheilkunde*, Bd. XIII, 1905, p. 346) has lately endeavoured to ascertain experimentally the action of silver nitrate (1 per cent. and 2 per cent.), silver acetate (1 per cent. and 2 per cent.), and zinc sulphate ($\frac{1}{4}$ per cent.), upon certain bacteria when placed in the conjunctival sac

of rabbits. She employed for this purpose the gonococcus, the pneumococcus, the streptococcus, and the staphylococcus pyogenes aureus, which were introduced in pure culture into the sac, after the lacrymal puncta had first been sealed by a touch with the cautery. Into one of the eyes treated in this way, the silver nitrate, or citrate, as the case might be, was dropped, and then, at varying intervals of time (5 and 25 minutes), media were inoculated from each eye, and the number of colonies thereby obtained counted and compared. Urata concluded that the best method of prophylaxis was by the use of one or two drops of 1 per cent. silver nitrate, preceded by a careful cleansing of the skin of the eyelids and neighbouring parts with an aqueous solution of some mild antiseptic—as, for example, boric acid (1:50) or mercury oxycyanate (1:1000). Urata believes that the silver, which should be fresh, should be distributed throughout the conjunctival sac by gently separating the lids from one another several times. It will thus be apparent that she proceeds in a way diametrically opposed to that originally advocated by Credé.

The elaborate figures of Köstlin and of Cohn, published in the year 1896, made a comparison between the morbidity of ophthalmia in babies treated respectively with the 2 per cent. and the 1 per cent. solution of silver nitrate, very much to the disadvantage of the latter. Thus, among the first (24,724 babies) the figure stood at 0·65 per cent., and among the second (1,223 babies) at 4·422 per cent. In 1896 the balance of advantage was therefore markedly in favour of the Credé plan, pure and simple. A glance at the statistics given below, however, will show that the reverse is now the case. If we group together all babies* whose eyes were treated with silver of less than 2 per cent. concentration, we shall find that among 36,132 births, there was only 0·423 per cent. of primary ophthalmia. With these we may compare the extended figures given on page 182 of the present communication, according to which the morbidity of primary ophthalmia in 76,452 babies

* Andrews's figures dealing with 58 babies have not been included in the above calculation, because his results with 1 per cent. silver—17·24 to 20·68 per cent.—are so opposed to all experience that there must be some error. Had they been counted, the incidence of ophthalmia with weak silver solutions would have reached as high as 1·504 per cent.!

treated by the Credé plan was 0·703 per cent. These facts are embodied in the table to be next given :

A Table showing the percentage-incidence of Ophthalmia in 76,452 infants treated by Credé's plan, and in 36,132 infants treated with solutions of silver weaker than the 2 per cent. recommended by Credé.

Strength of Silver.	Number of Births.	Percentage of Ophthalmia.
2 per cent.	76,452	0·703
Weaker than 2 per cent. ...	36,132	0·423

The figures quoted from Queen Charlotte's Hospital (p. 187) show that in that institution somewhat better results followed the employment of a 1·6 per cent. solution than a 1 per cent. solution of silver nitrate. It is worth while, therefore, to enquire into the relative effects of the various strengths of silver used at other places and by other observers. The comparison is made in the following table :

A Table showing the percentage of Ophthalmia when different strengths of silver nitrate were employed in the prophylaxis.

Strength.	Births.	Percentage of Ophthalmia.
2 per cent.	76,452	0·703
1·6 , ,	6,941	0·230
1·5 , ,	1,091	—
1·3 , ,	377	0·26
1 , ,	18,393	0·628
0·6 , ,	8,927	0·31
0·25 , ,	403	0·24
Totals	112,584	0·338

It is a curious fact that the percentage of ophthalmia, as shown in the above table, is lower with the weaker solutions of silver than with the 2 per cent. solution originally recommended by Credé. Some of the returns, as those dealing with the 1·3

per cent. and the 0·25 per cent. solutions, are so small as to be almost valueless, but that remark does not apply to the 1 per cent. solution, with which the eyes of upwards of 18,000 babies have been treated, with an ophthalmia morbidity of 0·628 per cent. There appears to be no relation between concentration of the silver, on the one hand, and powers of prevention, on the other. It may be fairly claimed, however, that the figures, as a whole, show that the weaker solutions are, at all events, as protective as the stronger ones. Since it is acknowledged by everybody that the former produce less conjunctival reaction than the latter, the conclusion is inevitable that they should be preferred.

It is of some interest to note that as long ago as 1887, a Russian physician, J. Zwoow (ref. in *Rev. générale d'ophtalmologie*, 1888, p. 28) compared the prophylactic value of solutions of silver nitrate weaker than that recommended by Credé, and came to the conclusion that solutions of $\frac{1}{2}$ per cent. to 1 per cent. prevented the development of ophthalmia.

Before leaving the subject of silver nitrate it should perhaps be mentioned that G. Krukenberg, of Bonn (*Arch. f. Gynäk.*, XXII, Heft 2, p. 329, 1884), who prior to adopting preventive measures had 7·3 per cent. of ophthalmia in 1,266 births, employed an ointment containing 2 per cent. of the silver salt, which he applied himself by means of a small glass rod to the infants' eyes, first cleansed by means of wool and 2 per cent. solution of carbolic acid. By these means he met with 0·142 per cent. of primary ophthalmia in 703 babies. It is interesting to note that when Krukenberg used a 2 per cent. solution of carbolic acid alone, the morbidity of ophthalmia was 13·4 per cent.—that is to say, nearly twice as great as it had been when no prophylactic measures whatever were adopted! More recently, N. B. Jenkins (*Medical Record*, October 29, 1898) has proposed to substitute a silver emulsion for the silver drops. His formula was as follows: silver nitrate, grs. v-x; distilled water and liquid petrolatum, of each half-an-ounce.

Among the other preparations of silver that have been used in the preventive treatment of ophthalmia must be mentioned the acetate and the citrate salts, as well as argentamine, protargol, argyrol, and sophol.

Silver Acetate.—Zweifel (*Centralbl. f. Gynäk.*, December 22, 1900) employed a saturated aqueous solution—i.e., about

1·25 per cent. at room temperature—of silver acetate, and spoke enthusiastically of the liquid, from the employment of which he had never witnessed any reaction. It was used in 5,222 babies, with twelve cases of ophthalmia, or 0·229 per cent. One drop only was put into each of the infant's eyes, and any surplus was neutralized with a weak solution of common salt. Leopold (*Berl. klin. Wochenschr.*, 1902, No. 33) employed a similar solution in 172 newly-born children, without an early infection. His observations are important, since he paid particular attention to the presence or absence of conjunctival reaction. In point of fact, of the total number treated, he found in ten only some slight irritation during the first 24 hours, but this disappeared without treatment. Leopold did not think neutralisation necessary. E. Scipiades (*American Medicine*, September 26, 1903) employed the 1 per cent. solution of silver acetate in 475 newly-born babies with excellent results—no instance of blennorrhœa. Reaction, according to Scipiades (*Centralbl. f. Gynäk.*, April 11, 1903), occurs, on the average, in 21·2 per cent. when silver acetate has been used to the eyes, as compared with silver nitrate 96 per cent. and protargol 20 per cent. to 80 per cent. The latest figures with regard to silver acetate are those furnished by Dauber (*Münch. med. Wochenschr.*, February 16, 1904). That author employed, as did Zweifel, Leopold, and Scipiades, the 1 per cent. solution. Among 149 babies, Dauber met with no ophthalmia. Reaction was present in 15 per cent. of his cases. In a second series, the acetate was applied to the eyes of 126 babies, again without any ophthalmia. The salt was not neutralized. 6·3 per cent. of the infants manifested more or less reaction. Thies (*Münch. med. Wochenschr.*, 1906, No. 33) has quite lately endorsed the use of the 1 per cent. silver acetate.*

Silver citrate.—"Itrol" (the commercial name for silver citrate) was recommended by Luciani (*Annali di Ottal.*, Vol. 39, fasc. 4) and by Schatz (*Centralbl. f. Gynäk.*, October 14, 1899). The last-named employed a 3 per cent. solution. A solution of silver citrate was used by Zweifel in 43 babies, with two cases of ophthalmia, or 4·6 per cent.

Argentamine. — Argentamine (ethylene - diamine - silver-

*Infection occurred in 0·25 per cent. of the 2,000 eyes treated with 2 per cent. silver nitrate, and in 0·15 per cent. of the 2,000 eyes treated with 1 per cent. silver acetate.

phosphate) has been recommended in the preventive treatment of blennorrhœa neonatorum by Daxenberger (*Deutsche Medizinal-Ztg.*, 1901, No. 4, p. 46). Hoor (*La Clinique Ophtal.*, November 25, 1897), with 5 per cent. argentamine, had in 115 babies three serious early infections (2·60 per cent.), and two infections six to eight days after labour (1·73 per cent.) This somewhat discouraging result Hoor attempted to discount by saying that the numbers dealt with were too small to reach a conclusion on. No reaction followed the use of the medicament in 63·47 per cent. of the cases.

Protargol.—Protargol, a laboratory product with marked antiseptic properties, which contains 8·3 of silver, has been tried rather extensively in the prophylactic treatment of ophthalmia. Fuerst (*Fortsch. der Med.*, February 15, 1898, No. 4) recommended the 10 per cent. solution, which he claimed was less irritating, less readily decomposed, and easier to handle than silver nitrate. Darier (*La Clin. Ophtal.*, March 25, 1898) advised the use of 10 per cent. or 15 per cent. solutions, which he stated caused no irritation. E. S. Peck (*Philadelphia Medical Journal*, December 17, 1898) believed that protargol might advantageously be substituted for silver nitrate in the prophylaxis of ophthalmia neonatorum. Viggo Esman (*Archiv für Augenheilkunde*, Bd. XXXVIII, Heft 4) treated 277 newly-born babies with protargol—i.e., 29 with a 2 per cent. solution, and 248 with a 1 per cent. solution. Silver catarrh was set up in 20 per cent. of the infants. This author found protargol less irritating than, but not so efficient as, silver nitrate, as might naturally be expected from the weak solutions he employed. F. E. Cheney (*Boston Medical and Surgical Journal*, August 25, 1898) quoted a personal communication made to him by W. L. Richardson with regard to the use for about three months at the Boston Lying-in Hospital of a 2 per cent. solution of protargol, which was stated to produce no re-action such as followed the employment of 1 per cent. silver nitrate. No precise figures, however, were adduced. Zweifel used protargol first as a 20 per cent. solution, and then as a 2 per cent. watery solution. The eyes of 44 babies were treated with the former. There was an absence of ophthalmia, but, on the other hand, there were many instances of intense silver catarrh of the conjunctiva.

On that account Zweifel was compelled to resort to the weaker solution, with which irritation was absent, but there were three cases of ophthalmia—that is, 1·06 per cent.

Norton L. Wilson (*Philadelphia Medical Journal*, February 11, 1899) thought that protargol might replace silver in the prophylaxis of ophthalmia, although he related a case where ophthalmia developed on the fifth day in a child (whose mother was delivered on the steps of the hospital) after the use of a 5 per cent. solution of protargol. This case, of course, proves nothing.

Fritz Engelmann (*Centralbl. f. Gynäk.*, July 29, 1899 and January 5, 1901) used a 20 per cent. solution in 1,000 births, and had a single case of ophthalmia, or 0·1 per cent. By adopting precautions in the making of the solution—a point on which he laid considerable stress—80 per cent. of his cases remained free from irritation. In Cramer's hands (*Centralbl. für Gynäk.*, October 14, 1899) a 20 per cent. solution of protargol had yielded good results. Guerola (*Anales de Oftal.*, November, 1900) used a 10 per cent. to 15 per cent. solution of protargol. T. Piotrowski (*Centralbl. f. Gynäk.*, August 3, 1901) employed 20 per cent. protargol in 170 births, and had one case of ophthalmia, while 56 per cent. of the infants manifested no conjunctival reaction. Piotrowski then adopted 10 per cent. protargol in 1,030 births, without a single instance of ophthalmia. Moreover, 90 per cent. of the babies showed no reaction. This author spoke enthusiastically as to the value of protargol. L. Hiers (*Georgia Journal of Medicine and Surgery*, January, 1902), recommended "that the washing of the eyes with protargol should be made obligatory in private obstetrical practice." Rosner (*Medic. Blätter*, April 16, 1903) employed the 10 per cent. solution in 1,030 babies without meeting with a case of ophthalmia. J. Veverka (*Heilkunde*, January, 1903) working in Rubesca's klinik at Prague, from March, 1900, to February, 1901, employed a 20 per cent. solution and had no infections in a list of 1,100 births. Four late (seventh or eighth day) gonococcal infections were observed. In addition to using the protargol, Veverka washed the eyes with wool dipped in 3 per cent. boric acid—once before and once after the cord had been cut.

Cragin (*Medical Record*, September 23, 1905, p. 521)

has given some interesting but not very conclusive information with regard to the method of prophylaxis adopted during a period of six years at the Sloane Maternity, New York. During the first two years silver nitrate was employed almost exclusively, but during the second and third two years "solutions of two of the organic silver salts had been substituted." In the entire period under review, so Cragin states, the sight of one eye had been lost, and that was during the time when one of the organic solutions was in use.

Among 3,009 babies treated by v. Herff at the Basle Maternity with 10 per cent. protargol (*Munch. med. Wochenschr.* 1906, No. 20), not one developed primary infection, and only two (0.06) a late infection. v. Herff declared protargol to be as efficient as silver nitrate and at the same time less irritating.

Tada Urata (*Zeitschr. f. Augenheilkunde*, Bd. XIII, 1905, p. 342) on experimental grounds, was of opinion that protargol was able completely to replace Credé's method.

The 20 per cent. solution protargol was employed prophylactically at the Glasgow Maternity Hospital for several years, but I am informed by Dr. Robert Jardine, senior physician to the hospital, that in the year 1906, when Credé's treatment was adopted, there were 574 babies born alive and four cases of ophthalmia, or 0.69 per cent.

On the other hand, Chrobak (ref. in *Centralbl. f. Gynäk.*, August 20, 1904, p. 999) after experimenting with 5 per cent. protargol in 3,000 babies, has returned to the use of 2 per cent. silver nitrate. J. Clifton Edgar (*Medical News*, September 23, 1905), again, after repeated trials of protargol, has found nothing equal to silver nitrate, 2 per cent.

Argyrol.—Argyrol, or silver vitelline, a comparatively new product stated to contain 30 per cent. of silver combined with a proteid, has made for itself a great reputation in the treatment of external diseases of the eye. It is extremely soluble in water, and is practically devoid of irritating qualities. For the purpose of preventing ophthalmia neonatorum, it has been recommended by Darier, Allport, Cragin, Hirst, Jackson and de Schweinitz, Zweifel, v. Herff, and others.

The 20 per cent. solution was recommended by Darier in his well-known *Leçons de Thérapeutique Oculaire* (second edition, 1907, p. 198). W. Allport (*Birmingham Medical Review*, 1903, No. 54, p. 770) after witnessing two instances of conjunctival inflammation from the use of the Credé method, advised that 20 per cent. argyrol should be substituted for the silver nitrate in the out-door midwifery department of the Queen's Hospital, Birmingham. Allport regarded argyrol as being as efficacious as silver nitrate, since "during the three months this has been used, there have been no cases of ophthalmia, and only in one case was there a very slight reaction after its use." The value of Allport's statement is, however, lessened by the unfortunate omission of confirmatory figures. Cragin advised that immediately after birth the eyes of the baby be irrigated with boric acid solution, and that 20 per cent. argyrol be instilled. B. C. Hirst wrote: "Since using argyrol in a 25 per cent. solution, I have diminished the proportion of ophthalmia cases in the hospital to between 1 per cent. to 3 per cent. of the infants born, out of a total service, in the hospital and dispensary, of 900 to 1,000 cases a year. Without looking up the records, which would take considerable time, I should say we had less than a third of the cases of ophthalmia with argyrol than we used to have with nitrate of silver as a preventive treatment. Before applying argyrol we used protargol in place of nitrate of silver, but I should say from clinical observations that the argyrol was much superior to either." Jackson and de Schweinitz (*Ophthalmic Year Book* for 1905, p. 44) say that "in the institution under the care of Dr. B. C. Hirst, in the hospital of the University of Pennsylvania, statistics not yet published, where argyrol has been made to take the place of the Credé method, at least in all cases where a virulent gonorrhœal infection prior to birth was not established, so far as the writer is aware, within the last year only three cases have developed, and these were mild and yielded promptly to treatment." Jackson believes that this indicates an efficiency which may be trusted, but in a doubtful case still feels that the Credé method, properly applied, is better. Zweifel (quoted by Edgar, *Medical News*, September 23rd, 1905) experienced only 0.23 per cent. of ophthalmia amongst 5,000 babies treated with argyrol. v. Herff (*Münch. med. Wochenschr.*, 1906, No. 20) treated 650 babies

with argyrol without any early infections.

The last figures* respecting argyrol refer to its use at the lying-in wards of the Liverpool Workhouse, and have been kindly furnished to me by Dr. William Alexander, Visiting Surgeon to the institution. The prophylactic measures adopted include syringing the vagina, before labour begins, with a quart of sublimate, 1 : 1,000, and washing the eyes of the baby, as soon as it is born, with boric lotion, five grains to the ounce. A solution of argyrol, 20 grains to the ounce (that is, about 4 per cent.) is then dropped into each eye. The following table embodies the results for a period of four consecutive years, 1903-1906 inclusive :

Liverpool Workhouse.

Year.		Living Babies.	Ophthalmia.
1903	...	306	1.33
1904	...	313	—
1905	...	346	0.57
1906	...	369	0.27
Totals	...	1,334	0.52

Sophol.—Sophol, a product which contains 20 per cent. of silver in so-called "masked" form, has been tried by v. Herff (*loco citato*) to the eyes of 1,050 babies, with one early infection, thought by the author to be probably of ante-partum origin.

Corrosive sublimate.—Sublimate in various strengths has been used extensively in the preventive treatment of ophthalmia. Bröse, who by the use of the Credé method among 460 babies, had 1.5 per cent. of ophthalmia, was induced by the symptoms of irritation set up by the silver to adopt instead a 1 : 1,000 sublimate, which, in his experience, was not accompanied or followed by such untoward appearances (ref. in *Arch. de Tocologie*, No. 11, 1884, p. 374.) In the same year Rossander (ref. in *Rev. générale d'ophthalmologie*, 1884, p. 497)

*At the Newcastle-on-Tyne Poor-Law Maternity Wards, 20 per cent. argyrol is dropped into the eyes with a view of preventing ophthalmia. Among 366 infants treated by these means ophthalmia occurred in 0.54 per cent. (Samuel S. Whillis).

recommended sublimate in preference to silver nitrate. Gayet (*Province méd.*, 1887, No. 23, ref. in *Centralbl. f. Gynäk.*, March 10, 1888) advised douching both the mother's vagina and the baby's eyes with sublimate, 1 : 6,000. C. H. Stratz (*Centralbl. f. Gynäk.*, April 25, 1888) employed 1 : 1,000 solution in 965 babies, and the percentage of ophthalmia stood at 0·6. In a second series of 50 babies, where sublimate of similar strength was used, there was one ophthalmia, with cocci, on the fifth day. Hence, in 1,015 babies there were seven cases of ophthalmia—all late infections—or 0·68 per cent. In a further series of 460 infants the same author adopted a 0·02 per cent. sublimate, and under those circumstances had two cases (0·43 per cent.) of ophthalmia. Reaction was noted in 18·3 per cent. of the children, although it was stated to be less severe than with the Credé method. Among the 460 mothers in Stratz's last series were 25 with granular colpitis, and of the babies belonging to those women, one was affected on the fifth day with conjunctival catarrh and another on the same day with gonococcal ophthalmia. The results obtained by Stratz may be summed up by saying that amongst 1,473 babies whose eyes were treated with sublimate, 1 : 1,000 and 0·02 per cent., nine were affected with ophthalmia on or after the fifth day—0·610 per cent. Fritsch (quoted by Stratz), among 486 babies in the Breslau Klinik treated with sublimate of unnamed strength, had two cases of ophthalmia, or 0·4 per cent., both on the seventh day after birth. Schröder used sublimate, 1 : 10,000 and 1 : 5,000. The former he applied to the eyes of 1,015 babies, with seven cases of ophthalmia, or 0·68 per cent. ; the latter, to 460 babies, with one case of ophthalmia, or 0·217 per cent. Dolériss, who employed a 1:6,000 solution, had 0·856 per cent. in 584 babies. v. Erdberg, with a 1 : 5,000 solution, noted 0·43 per cent. of ophthalmia among 450 babies. Küstner, with the 1 : 7,000 solution, in 450 infants, had 0·43 per cent. of ophthalmia. Ahlfeld adopted a 1 : 5,000 and Troussseau a 1 : 2,000 solution.

C. J. Cullingworth (*Medical Record*, September 14, 1889) advised the use of a 1 : 3,000 solution, after the baby's head had first been wiped with a clean cloth, if possible before the eyes were opened. Callaert (*Ann. d' Oculistique*, Tome 154, 1892,

p. 154) recommended 1 : 5,000 sublimate. Czempin (*Centralbl. f. Gynäk.*, December 5, 1896, p. 1,249), in private practice, employed several drops of sublimate, 1 : 1,000, to the baby's eyes. This method he had found trustworthy, and not liable to be followed by consecutive conjunctivitis.

P. Muller (ref. in *Rev. générale d'ophthalmologie*, 1897, p. 169) states that in the obstetrical klinik at Berne Credé's method had been used for about 15 years, and no eye had been lost. But as silver was capable of producing an artificial inflammation which might mask an ulterior infection, sublimate was eventually substituted, with the result that the preventive effects were not less favourable, while artificial ophthalmia became less common.

With reference to the question of the Credé method *v.* the use of sublimate, v. Erdberg (ref. in *Centralbl. f. Gynäk.*, June 17, 1893) quoted the following figures:

Method.	Births.	Ophthalmia.	
		Cases	Percentage
Credé. ...	14,870	116	0.78
Sublimate ...	2,778	2	0.10

v. Erdberg believed that sublimate was preferable to 2 per cent. silver nitrate, although he admitted that the figures referring to the mercury salt were as yet too small to render a final conclusion trustworthy.

On the other hand, Widmark (*Rev. générale d'ophthalmologie*, April, 1888) quoted figures with regard to the two Swedish maternity hospitals, namely, those of Stockholm and Gothenburg respectively, which told a different tale. But the figures, which are given below, are again too small for any definite conclusion, and there is not indeed much difference between the percentages.

Method.	Births.	Percentage of Ophthalmia.
Credé	1,153	0.53
Sublimate, 1 : 1,500	1,157	0.70

The Obstetrical Society of London, which, prior to the year 1905, when the Central Midwives Board was instituted under the Midwives Act, 1902, issued diplomas to midwives, inserted the following recommendation in their rules :—
“As soon as the child’s head is born, and, if possible, before the lids are opened, its eyelids should be carefully wiped with pledges of absorbent wool soaked in corrosive sublimate solution (1 in 4,000), and as soon as practicable after birth a few drops of the above solution should be dropped into each eye.”

The rule as originally laid down by the Central Midwives Board ran as follows : *“As soon as the child’s head is born, and, if possible, before the eyes are opened, its eyelids should be carefully cleansed with a suitable antiseptic lotion.”* But under the revised rules, which came into effect in February, 1907, the last five words of the rule quoted above were omitted.

At the British Lying-In Hospital, London, the eyelids are wiped, after delivery of the child’s head, with a wool pledge soaked either in mercury biniodide or perchloride, 1 in 1,000. When the baby is born, the eyelids are separated, and a few drops of sublimate, 1 in 2,000, are dropped in. During a period of nine years, in which 7,090 confinements have occurred, there have been six cases of ophthalmia, namely, three afflicted at birth (ante-partum cases), and three upon the eighth day after delivery.

At the General Lying-In Hospital, Lambeth, London, according to Dr. Robert Boxall, a 1 : 3,000 sublimate solution is dropped into the outer corner of each eye as soon as the baby is born. No figures, however, can be obtained from that institution.

In the out-door department of Queen Charlotte’s Hospital, London, the baby’s eyes are washed as soon as possible after birth with wool and sublimate, 1:4,000, and after the bath has been given two or three drops of the same solution are put into the eyes.

Sublimate of various strengths is used at many of the poor-law institutions mentioned on page 7 *et seq.**. It should not be forgotten that several ophthalmic surgeons, as Pflüger, Abadie, Valude, Jocqs, Kalt, Parinaud, and Dor, believe (whether rightly or wrongly, I do not pretend to say) that even

* See foot note on page 206.

weak solutions of sublimate are injurious to the corneæ of babies, which it tends to render opalescent. An anonymous writer in the *American Journal of Ophthalmology* for May, 1892 (p. 150), makes a similar suggestion. From this point of view, therefore, there is perhaps more to be said against mercury than against silver.

Carbolic acid.—Carbolic acid, it need scarcely be said, was early in the field. Already in the year 1876 Schiess (*Corr.-Blatt f. schweiz. Aerzte*, 1876, p. 674) published an article in which he advocated irrigation of the vagina with carbolic acid before and during labour, along with the application to the eyes of the baby, immediately after birth, of 0·5 per cent. carbolic or $\frac{1}{10}$ per cent. thymol. Angus Macdonald (*Edinburgh Medical Journal*, 1881, p. 114) employed a 2 per cent. solution of carbolic acid both to wash the face and to drop into the eyes of the new-born infant. Under this treatment, Macdonald had one case of ophthalmia in 56 babies (1·78 per cent.). Hohl (*Neue Zeitschr. f. Geburts.*, XII, XV, XVII), who prior to prophylaxis had from 12 per cent. to 20 per cent. of ophthalmia, used a 2 per cent. solution of carbolic acid in 1879 and had 8·8 per cent. of ophthalmia. In the following year, with the same solution, he had 3·6 per cent. of ophthalmia among 166 babies. R. Olshausen (*Centralbl. f. Gynäk.*, January 22, 1881, p. 33), on the recommendation of A. Graefe, of Halle, used drops of 1 per cent. carbolic acid before and after cutting the cord, and by those means had an ophthalmic morbidity respectively of from 3·6 per cent. in 166 children to 8·8 per cent. in 137 children. As indirect results of this method, Olshausen noted mildness of the cases of ophthalmia which did occur and a tendency of the disease to affect one eye alone. Olshausen later employed a 2 per cent. solution, and combined with it a careful preliminary cleansing of the eyelids. But he gave no figures to show what results had been obtained by those measures. Fieuzal advocated irrigation of the eyes with a 4/10 per cent. solution of carbolic acid, together with the subsequent use of cold compresses. Spath, who used a 1 per cent. solution, met with 1·4 per cent. of ophthalmia. Königstein (*Arch. f. Kinderheilkunde*, Bd. III, Heft 9 and 10, 1882, p. 341), by the employment of a 1 per cent. solution in 1,541 babies, had 21 cases, or 1·36 per cent.,

of ophthalmia. There were in his series also 96 catarrhs—6·23 per cent. Krukenburg (*Arch. f. Gynäk.*, XXII, p. 329), with a 2 per cent. solution among 82 infants, actually recorded 11 cases of ophthalmia, or the astonishing figure of 13·4 per cent. Haussmann employed a 2 per cent. solution both for douching the mother's vagina and for dressing the infant's eyes; and de Wecker recommended the employment of a similar solution.

Boric acid.—A 4 per cent. solution of boric acid was lauded by de Wecker, and a 3 per cent. solution employed by Connent. The figures given by the latter author (*Thèse de Paris*, 1884), were, however, such as to deter most people from employing boric acid in the prophylaxis of ophthalmia. Used as a lotion twice daily to the eyes of 223 babies, this plan yielded 4·54 per cent. of ophthalmia. Zweifel (*Centralbl. f. Gynäk.*, December 22, 1900) used a 3 per cent. solution to the eyes of 223 babies, and encountered 4 per cent. of ophthalmia among the infants thus treated. Doléris had 6 per cent. of ophthalmia in 123 births; Tarnier, 3·5 per cent. in 132 births; and Widmark, 0·59 per cent. in an unstated number of births. At the New York Maternity Hospital on Blackwell's Island, according to enquiries made by C. H. May (*Medical Record*, February 16, 1895), where the births averaged 300 per annum, a saturated solution of boric acid had been substituted for silver nitrate, and the impression was that the results were just as good. Figures seem to be badly needed here! Another intangible statement was that made by N. L. North (*Boston Medical and Surgical Journal*, January 15, 1899, p. 16) to the effect that a saturated solution of boric acid was quite as efficient as silver nitrate in the prophylaxis of ophthalmia neonatorum. Despagnet (*Rev. gén. d'ophthalmologie*, 1896, p. 219) had 2 per cent. of ophthalmia during one year at the Saint-Germain Maternity Hospital where boric acid was employed to the eyes of the newly-born babies.

Iodine trichloride.—This is another substance that has been employed in place of silver. It was used by Buchholz (*Disser. Dorpat*, 1893) on 201 babies, with 1 per cent. of ophthalmia, and by Keilmann (*Schles. Ges. f. vaterl. Cultur.*, January 25, 1895) on 560 babies, with 1·4 per cent. of ophthalmia.

Salicylic acid.—Compresses of salicylic acid, it will be remembered, were used by Crédé in his earlier experiments, in order to cool the eyes after the application of the 2 per cent. silver nitrate. Bischoff employed salicylic acid washes for the baby's eyes and carbolic douches for the mother's vagina. The most complete set of statistics, however, were those given by Caro in his inaugural thesis (ref. in *Centralbl. f. Gynäk.*, September 17, 1887). In the Königsberg klinik from 1877 to 1883 vaginal douches of carbolic and cleansing of the baby's eyes with 0·3 per cent. salicylic acid were carried out. Of 2,130 babies born alive, a total of 33, or 1·55 per cent., became diseased, although after deducting late infections, the figure stood at 1·03 per cent. Caro then tried the effect of applying the salicylic acid before the baby opened its eyes, and had no case of infection. He argued that as silver nitrate applied according to Crede's directions caused local irritation, the use of salicylic acid before the baby opened its eyes was preferable, more especially as the latter was equal in protective power to the former substance.

Permanganate of Potash.—Permanganate of potash, of course, has been tried—at first by Valenta and then by Pinard. Valenta (*Wiener klin. Wochenschr.*, 1890, p. 671) employed an 0·6 per cent. solution, with which he had 2 per cent. of ophthalmia. He considered silver nitrate too dangerous to be entrusted to midwives. Sourisse (ref. in *Annales d'oculistique*, Tome 116, 1896, p. 389) believed that the permanganate would prevent gonococcal ophthalmia. Pinard (*Ann. de Gynéc. et d'Obstét.*, January, 1902) used a 1:1000 solution to 1,316 babies at the Clinique Baudelocque from November, 1900, to June, 1901, and noted 23 cases of ophthalmia, or 1·4 per cent. Of these cases, seven occurred in the first four days and sixteen after that.

The permanganate treatment of ophthalmia neonatorum is of some little historical interest, since in February, 1900, the French Senate, on the proposition of Dr. Pédebidou, a medical member, invited the Government to address to every midwife a circular recalling to her mind the fact that potassium permanganate was a sovereign remedy in ophthalmia neonatorum. Pinard's report, however, together with other official medical documents, was enough to cause the French Government to abandon the Senate's proposition.

Iodoform.—In 1891 Valude (*Annales d'oculistique* and *Gaz. des Hôpitaux*, August, 1891) praised finely pulverised iodoform* as a means of preventing ophthalmia, although the figures he quoted, it must be confessed, were the reverse of encouraging. They were as follows:—of 264 babies treated with iodoform at the Hôpital Saint-Louis, Paris, 13, or 4·9 per cent., were attacked by the disease. At Tarnier's clinique, where the surroundings, etc., were somewhat better, five cases of ophthalmia occurred in 248 babies treated with iodoform—2·01 per cent. The conditions of this clinique may perhaps be best gauged from the fact that Credé's plan, as practised there, yielded no less than 5·9 per cent. of ophthalmia. Seguin (*Thèse de Paris*, 1892) met with 42 cases among 1,382 children, that is, 3·039 per cent. The statement has been made by Saint Philippe (*Arch. de Tocologie et d'Obstét.*, November, 1892) that infants bear powdered iodoform badly, since it makes them refuse the breast and renders them somnolent. Vignes (*Ann. d'oculistique*, Tome 115, 1896, p. 356) found greater reaction follow the use of iodoform than of silver to the eyes. Romiée (*Le Scalpel*, February 2, 1896) averred that iodoform produced swelling and redness of the conjunctiva, although little secretion.

The indifferent results obtained in the preventive treatment of ophthalmia by iodoform make it difficult to understand the grounds of a recent statement by J. W. Ballantyne (*Manual of Ante-natal Pathology and Hygiene (the fetus)*, 1902, p. 53), to the effect that “it is now no longer thought to be necessary to use nitrate of silver solution as a prophylactic, for it has been found that insufflation of iodoform powder into the new-born's eyes does as well.”

Formalin.—A 1 per cent. solution of formalin has been employed by Zwiefel (*Centralbl. f. Gynäk.*, December 22, 1900) to the eyes of 120 babies, with four cases, or 3·3 per cent., of ophthalmia.

The same observer employed also two strengths of the ethyl-dionine of mercury, one containing 0·15 per cent. and the other 0·3 per cent. of the pure substance. With the former he had 2 cases of ophthalmia in 12 babies, and with the latter 5 cases in 321 babies.

* Recommended in 1881 by Baumeister.

Zinc Sulphocarbolate.—This substance was employed in solution by Schröder, who had 3 per cent. of ophthalmia amongst the babies to whose eyes it was applied. In 1885 an 0·5 per cent. solution of the same substance was used by Ernst Cohn (*Zeitschr. f. Geburts. u. Gynäk.*, XIII, 2, 1887) to the eyes of 500 children, of whom one alone (0·2 per cent.) became diseased. Later, these instillations were replaced by sublimate douchings of the vagina and simple cleansing and drying of the child's eyelids. Among 653 children treated in this way, 13 cases of ophthalmia, or 1·9 per cent., were met with, or after deducting late infections, 1·2 per cent.

Lemon Juice.—Fresh lemon juice was praised by Pinard as a safe, efficient, and convenient substitute for silver nitrate. By this means he treated, during the years 1890, 1891, and 1893, the eyes of 4,458 babies. Among these children the total number of cases of ophthalmia was 61, or 1·37 per cent. Swawelski (ref. in *British Medical Journal*, epitome No. 378, 2, 1896) endorsed Pinard's statement as to the value of fresh lemon juice as a means of preventing ophthalmia. In his experience, the application was painless. It caused, as a rule, no irritation, and slight catarrhal phenomena were exceptional. Platon (Queirel's *Leçons de Clinique Obstétricale*, Paris, 1902, p. 286) had three cases of ophthalmia among the 550 babies delivered in the year 1900 at the Marseilles Maternity.

Citric acid.—Pinard employed a 5 per cent. solution of citric acid, over a term of seven years, to the eyes of 15,000 infants at the Clinique Baudelocque, with 166 cases of ophthalmia, or 1·10 per cent.

*Aniodol.**—Thomin (*Thèse de Paris*, 1901) employed a 1 : 4,000 solution of 1 per cent. aniodol to the eyes of newly-born babies with the idea of preventing ophthalmia. It was used in this way to 926 children born alive, but since, of that number, 22 succumbed shortly after birth, 904 remained for observation. Among this number there were seven instances of ophthalmia, of which five declared themselves in the first five days and two after. This gives 0·55 per cent. of primary and 0·77 per cent. of total infections. A. Pinard tried the same solution in 940

* A 1 per cent. solution of trioxymethylene with an allyle derivative and a little added glycerine.

babies at the Clinique Baudelocque in Paris, and placed the morbidity of ophthalmia at 0.74 per cent. Queirel (ref. in *Rev. générale d'ophtal.*, 1905, p. 408) also employed aniodol to the eyes of the baby immediately after birth, and characterised the liquid as neither caustic nor irritating.

Alcohol.—50 per cent. and 70 per cent. alcohol have been tried by A. König in the Marburg Frauenklinik (ref. in *Centralbl. f. Gynäk.*, March 2, 1901, p. 235). With the first-named 449 babies were treated, and with the second 271 babies, and the morbidity of ophthalmia in each series stood at 1.34 per cent. and 1.48 per cent. respectively. Accordingly, the figures for the total number of children (720) was 1.41 per cent. Although the returns for the two strengths of alcohol differed by 0.14 per cent. only, yet König found that the individual cases of ophthalmia were less intense when the stronger had been employed. As an offset to this advantage, however, it is to be noted that in the first group ten babies—that is, 2.22 per cent.—developed what may be termed a medicamentous conjunctivitis, while in the second group 14 were affected—that is, 5.18 per cent. König surmised that the employment of absolute alcohol would probably abolish purulent ophthalmia, although he was constrained to admit that it would cause a large amount of medicamentous inflammation of the conjunctiva.

Before instituting a comparison between the results obtained by the various agents mentioned in the foregoing pages, it is desirable to make one or two remarks suggested by the figures. First, some of the figures quoted—as, for example, those which deal with silver citrate, iodoform, alcohol, and iodine trichloride—are too small to render anything like a final conclusion trustworthy. Secondly, the figures, although included in the table, are not equated, so that comparison is somewhat unfair. Thus, in certain instances, observers have drawn no clear distinction between primary and secondary A ophthalmia, on the one hand, and secondary B, on the other. Yet for reasons already stated, the use of silver nitrate or of any other prophylactic agent can be expected to prevent the former only. Whenever a writer rendered it possible to distinguish between the two kinds of infection, early and late, the primary alone has been included in the table. Another fallacy lies in the fact that some authors fail

to differentiate between catarrhal and blennorrhœal inflammation of the conjunctiva. Thirdly, a false impression may be conveyed unless percentages are calculated, not upon the total number of births, but upon the number of babies born alive and surviving for the first week or so—that is to say, during the period when ophthalmia is most likely to develop. It should be stated, finally, that the only observations noticed are those where authors have stated both the total number of babies treated and the number of cases of ophthalmia.

Table showing the Number of Births and the Percentage of Ophthalmia recorded with different chemical agents used in the prophylaxis of Ophthalmia neonatorum :—

Agent.	Births.	Percentage of Ophthalmia.
Silver nitrate, 2 per cent.	76,452	0.703
Silver nitrate, weaker than 2 per cent....*	36,132	0.423
Silver nitrate ointment, 2 per cent.	703	0.142
Silver acetate, 1 per cent.	6,144	0.19
Silver citrate	43	4.65
Argentamine, 5 per cent....	115	2.60
Protargol	7,383	0.027
Argyrol	6,984	0.25
Sophol	1,050	0.095
Corrosive sublimate†	15,945	0.4069
Carbolic acid	2,148	5.42
Boric acid	701	4.51
Iodine trichloride	761	1.2
Salicylic acid	2,130	1.03
Permanganate of potash, 1:1,000	1,316	0.53
Iodoform	1,894	3.16

*Statistics from the City of London Lying-In Hospital, given on page 4, not included. At that institution, silver nitrate, 0.5 per cent., is used in all babies, preceded by swabbing the lids, directly after birth, with boric lotion. Percentage of ophthalmia, 0.113.

† Provincial Poor-Law returns not included in foregoing figures. At eleven of these institutions, sublimate, pure and simple, of a strength ranging from 1:2,000 to 1:6,000, is used in the prophylaxis. Amongst 3,005 living births, the ophthalmia cases were 0.7749 per cent.

Agent.	Births.	Percentage of Ophthalmia.
Formalin, 1 per cent.	120	3.3
Zinc sulpho-carbolate, 0.5 per cent. ...	500	0.2
Lemon juice	5,008	1.27
Citric acid, 5 per cent.	15,000	1.10
Aniodol	1,844	0.645
Alcohol, 50 per cent. and 70 per cent. ...	720	1.36
Hermophenyl	250	0.40

Benjamin Gibson (1807) enjoined practitioners, in order to prevent ophthalmia in the baby, "to remove artificially as much of the discharge as possible from the vagina at the time of delivery." This is, of course, a clear reference to the practice of douching the maternal passages during the progress of labour. This plan was recommended by Wendt (1835), Elsässer (1835), Sonnenmayer (1839), Whitehead (1847), Walton (1865), Kehrer (1873), Bischoff (1875), and Haussmann (1879). Credé tried disinfection of the genital passages, to begin with only in females suffering from gonorrhœa, but since this proved inadequate to stem ophthalmia, it was afterwards used to all pregnant women who entered the Leipsig institution early enough to allow of its being carried out. The results are inadequate, for the obvious reason that even the most careful douching was unable to remove or to destroy all infective material. Thus, among 60 women believed to have gonorrhœa who were treated in this way, the babies of 14, or 23.3 per cent., developed ophthalmia, sometimes of a severe type. Bayer (*Centralbl. f. Gynäk.*, August 19, 1882, p. 515), who had employed antiseptic douchings of the maternal passages since the year 1879, still had ophthalmia in from 12.9 per cent. to 14.3 per cent. of the babies. Horner (*Correspond.-Blatt f. schweizer Aerzte*, 1882, No. 7) believed that although vaginal douching was of service, yet it did not act well enough to be trusted to, except in conjunction with disinfection of the infant's eyes. de Wecker (*Gazette des Hôpitaux*, April 15, 1882) advised antiseptic injections during labour; that the baby's eyes should be washed separately from the body; and that the eyelids should be cleansed with 4 per cent. boric or 2 per cent. carbolic acid, or with 1 per

cent. mercury cyanide or oxycyanide (*La Clinique Ophtalmologique*, January 10, 1899), both before and after the bath. Ernst Cohn (*Zeitschr. f. Geburts. u. Gynäk.*, XIII, 2. 1887), who had 1.5 per cent. of ophthalmia with the Credé method and 0.2 per cent. with a solution of zinc sulphocarbolate (0.5 per cent.), was led to substitute for those measures simple disinfection of the vagina with sublimate. The results were far from encouraging. A somewhat important communication was published in 1887 by J. Zwoz (ref. in *Rev. générale d'ophtalmologie*, 1888, p. 28). That Russian observer, among other things, compared the effects of the Credé plan with those of sublimate injections during labour. With the former he met with no cases of ophthalmia, while with the latter 5 cases of ophthalmia occurred amongst 30 births. Zwoz succeeded in finding gonococci in the vaginal secretion, and especially in the cervix uteri, even after copious irrigations with sublimate, 1:2,000. He therefore argued that the employment of such means alone was incapable of preventing the development of ophthalmia neonatorum.

It cannot be doubted that douching of the vagina, and, especially, *careful cleansing of the external genitals*, with a suitable antiseptic solution, such as sublimate or permanganate or lysol, is capable of reducing the number of cases of ophthalmia. At the same time it must be a physical impossibility to rid the parts (especially the urethra and Bartholin's glands) of specific secretion, supposing such to be present, so that by those means the chances of subsequent infection of the baby's eyes are merely lessened and not by any means done away with. A greater measure of security is given when, together with douching of the mother's vagina, there is combined a scrupulous cleansing of the baby's eyelids, as in the method of Hill (1808), Jacob (1834), Hocken (1843), Whitehead (1847), Haynes Walton (1865), Schiess (1876), Hague (1879), Porter (1884), Kaltenbach (1886), Ahlfeld (1888), and others.

Abegg's experiences with distilled water as a means of preventing ophthalmia have been mentioned on an earlier page. It should be added that the same means have been employed by several other practitioners—as, for example, Schirmer (1882), Grünewald (1884), Kaltenbach (1886), Cohn (1886), Korn

(1887), Hofmeier (1890), Mermann (1892), and Rivière (1892). According to the figures given by Köstlin in 1895 (*Archiv für Gynäk.*, Bd. 50, Heft 2, 1895), of 5,823 babies whose eyes were treated with water, 3·122 per cent. developed ophthalmia.

Kaltenbach published in the *Centralblatt für Gynäkologie* for July 17th, 1886, particulars of a plan whereby he had met with no instance of ophthalmia among upwards of 200 deliveries. He held that the danger of infection of the eyes was not great during delivery, and, indeed, only likely to happen by the transfer of contagious material from one case to another, conveyed by digital examination, as might readily occur in badly-managed lying-in institutions. On this view, therefore, he employed sublimate (1 : 3,000) douches for the vagina during labour, and washed the baby's eyes, as soon as the head was born, with distilled water, but without allowing any of the fluid to reach the conjunctival sac. The method, which has come to be known as "Kaltenbach's plan," commended itself by reason of its simplicity and freedom from irritation. August Nebel (*Zeits. f. Geb. u. Gynäk.*, Bd. XIV, 1888, p. 185) adopted Kaltenbach's plan in 330 births without a primary infection. He had three slight late infections—one on the fourth and two on the eighth day. Among the advantages of the plan, Nebel enumerated its simplicity, thus allowing of its use by midwives, its freedom of any possibility of irritating the infant's eyes, and, lastly, the benefit it conferred upon both the mother and the child. The method had been used for two years with uniformly favourable results. Ahlfeld (ref. in *Centralbl. f. Gynäk.*, August 18, 1888, p. 535) ascribed the favourable results attained at the Marburg Klinik to the adoption of a plan similar in essential details to that advised by Kaltenbach. The vagina was douched with sublimate, 1 : 1,000, and when the baby's head was born, it was lifted clear of any possible source of maternal contamination, and the eyelids were then cleansed with perfectly clean water. There were 130 cases without a primary infection. Hofmeier (quoted by Nebel: *Münch. med. Wochenschr.*, February 18, 1890, p. 117), with the Kaltenbach plan, had among 365 babies born during 1889 at the Würzburg University Maternity no case of primary infection, and one only of late infection with gonococci.

Paul Brisken (*Münch. med. Wochenschrift*, February 2, 1892) using the Kaltenbach method from January 7, 1889, to January 15, 1890, in 308 births, had one infection on the eighth day. The method was next applied in 420 cases, and no specific disease of the eyes was observed. In a total number of 728 babies, therefore, there was no instance of primary infection and one alone of late infection. It should, however, be added that when, for some reason or other, the disinfection of the mother's genitals could not be carried out efficiently, the Credé method was also used by Brisken, a point that renders it a little difficult to appraise his figures at their true value. Brisken laid stress upon one fact, namely, that the Kaltenbach method was trustworthy only when the mother was under medical observation from the beginning of the labour. Rivière (*Arch. de Tocologie et de Gynécologie*, November, 1892) had seen six cases of ophthalmia in 35 births follow the use of the Kaltenbach method.

B. Bettman (*Journ. Amer. Med. Association*, August 12, 1893) adopted a somewhat analogous plan, which he attributed to Haussmann,* in the Cook County Hospital, during a period of five years, 1883-1888, in 1,232 babies, with the result that two instances only of blennorrhœa neonatorum were recorded. The method in question consisted of vaginal douches of 1 per cent. carbolic acid or of weak sublimate, but the author failed to state whether the eyes were treated in any way.*

Valenta (*Wiener klin. Wochenschr.*, 1890, No. 35), who thought that the Credé plan should not be employed except by medical men, proposed the following as a substitute:—a solution of potassium permanganate was extemporaneously compounded so that it had the colour of weak red wine, and with wadding dipped in this liquid, the baby's lids were washed over and wiped carefully. With a second bit of wadding, the conjunctival sac was washed out three or four times in succession. During the years 1858 to 1889, among 6,223 births, there had been, on the average, 3 per cent. of ophthalmia. With the method described

*Haussman's method, as described in the *Centralblatt für Gynäkologie* of February 19, 1881, consisted in carefully wiping the baby's eyelids free from any secretion immediately after birth by means of cotton-wool steeped in 1 per cent. carbolic acid.

above, the morbidity of the disease had been reduced to 1·6 per cent. from 2·7 per cent.

Finally, it will be remembered that the careful drying of the infant's eyelids immediately after birth was adopted as a means of preventing ophthalmia by Hague (1879), Schirmer (1882), Korn (1887), and Snell (1888). Korn originally used vaginal douches, in addition to careful cleansing of the baby's eyelids with plain water, but eventually he trusted to the latter precaution alone.

A plan very similar to that of Kaltenbach bears the name of Küstner. It consists in careful cleansing of the baby's eyes, either with sublimate, 1:7,000, or with iodine trichloride, 1:4,000, immediately the head is born, and before the shoulders have appeared. A. von Erdberg (ref. in *Centralbl. f. Gynäk.*, June 17, 1893) thus contrasts the methods with one another and also with Credé's plan:—

Method.	Births.	Ophthalmia.	
		Cases.	Percentage.
Credé.	14,870	116	0·78
Kaltenbach.	7,216	37	0·51
Küstner.	450	2	0·43

It will thus be apparent that several methods of prophylaxis essentially depend not, as in the Credé plan, upon the destruction of infective material that may have gained access to the conjunctival sac, but upon the prevention of such material reaching that position. These various methods may or may not be combined with the careful removal during labour of secretion from the maternal passages by means of vaginal douches of some weak antiseptic.

A factor that formerly appears to have been largely instrumental in infecting the infant's eyes was the water used in the first bath. Nowadays, when the practice is well-nigh universal of washing the infant's face apart from the rest of the body, the risks are much less. Paulsen (1875) advised that the face should not be washed in the water employed to cleanse the rest of the child's body. That W. O. Moore (*Medical Record*, September 20, 1879) was fully alive to the dangers of the first bath is shown

by the following sentence, penned in the year 1879:—"If the physician would attend more particularly to the first bath of the new-born, and not leave the entire charge to a nurse—perhaps an ignorant one—much trouble and suffering might be averted." Schirmer (1882) went so far as to characterise the fluid employed in the bath as "*Giftwasser*"—i.e., poison water—and acting upon his views with regard to its potential dangers, as already explained, simply dried the baby's face with a towel, and postponed the bath until the day following birth. H. V. Würdemann (*American Journal of Ophthalmology*, May, 1893) spoke emphatically with regard to the point. "The contagion," he wrote, "usually occurs after birth, being commonly due to negligence or ignorance of the nurse in washing the infant, whose face and eyes may be (?) cleansed in the same water as that of the body, and dried with the same cloth, the vernix being wiped away and the infecting material wiped in." At the Maternity attached to the Hôpital Saint-Antoine, Paris, so much importance is attached to the infective potentialities of the bath water, not only as regards the eyes but also as regards the umbilical cord, that no bath is given for some days after birth (Sevray, *Thèse de Paris*, 1902, p. 39). The child's skin is cleansed with wool steeped in a mixture of equal parts of 90 per cent. alcohol, glycerine, and water.

At the British Lying-In Hospital, London, where the amount of ophthalmia is almost negligible (see p. 4), the Matron, Miss Gertrude Knott, informs me that importance is attached to the careful drying of the infant's hands and arms, directly after birth, in order to prevent infection being carried to the eyes.

The figures given in the table on page 206 show that several antiseptic agents when applied to the eyes are capable of reducing the incidence of ophthalmia to an exceedingly low figure. We may put on one side all those by whose use ophthalmia amounted to 1 per cent. or upwards of the total number of births. In this way we at once exclude carbolic acid (5.42 per cent.), boric acid (4.51 per cent.), silver citrate (4.65 per cent.), formalin (3.3 per cent.), iodoform (3.16 per cent.), argentamin (2.60 per cent.), alcohol (1.36 per cent.), iodine trichloride (1.2 per cent.), lemon juice (1.27 per cent.), citric acid (1.10 per cent.), and salicylic acid (1.03 per cent.). Of the remaining agents,

the so-called organic salts of silver—that is to say, protargol, argyrol, and sophol—stand prominently forward with such low percentages as 0.027, 0.25, and 0.095 respectively. According to the facts at present before us, they appear to be most efficient agents in the prophylaxis of ophthalmia neonatorum. If we could judge of their trustworthiness on these grounds alone, we should be compelled to place them in the very front rank of prophylactic remedies, and it is quite likely that in the future they will be found to occupy this position. At present, however, the numbers at our disposal are too small to allow of a final judgment being made with regard to this point, although it is obviously one that will repay continued investigation. The same criticism applies to a less extent to corrosive sublimate also, by the employment of which among 15,945 babies the morbidity of ophthalmia stood at 0.4069 per cent. At the same time this agent enjoys great popularity, not only in poor-law lying-in wards, but also in several of the leading maternity hospitals. Its efficiency, indeed, cannot be doubted. It is cheap, and is carried by every midwife, additional points in favour of its use.

In point of fact, however, really large figures are reached only in the case of silver nitrate. Amongst 76,452 babies treated with the 2 per cent. solution of that salt the cases of primary ophthalmia amounted to 0.703 per cent., while amongst 36,132 babies treated with solutions weaker than the 2 per cent. it amounted to 0.423 per cent. These figures are large enough to exclude the likelihood of any purely statistical fallacy, which cannot perhaps be claimed for any of the other figures included in the table. Now two reasonable objections have been raised to the use of the 2 per cent. silver nitrate—first, the pain it causes, and, secondly, the reaction it is apt to produce. It will be admitted that the stronger the silver the greater is likely to be the reaction when it is dropped into a baby's eyes. The figures quoted on page 189 of the present communication prove that in practice better results have been obtained by the use of 1.6 per cent., 1.5 per cent., and by the 1 per cent. solution than by the 2 per cent. drops. On the evidence before me I therefore conclude that the 1 per cent. solution is fully protective, and in our present state of knowledge, may be regarded as the most efficient solution to employ in the preventive treatment of ophthalmia neonatorum.

It is free from many, if not from all, of the drawbacks that have tended to render some practitioners chary of using the stronger solution. In my opinion, it is as efficient as it is harmless. It should, I think, be employed, in all public institutions where women are brought to childbed, whether appearances of gonorrhœa are, or are not, present.

Admitting, as one is bound to do, that gonorrhœa in women may be present in latent form without betraying its existence to ordinary methods of examination, it would be only logical to apply the silver drops in all cases. But questions of expediency come in, and cannot in the very nature of things be wholly disregarded. Without doubt, some trustworthy plan of prophylaxis should invariably be adopted among the lower class of women confined at their own houses, who under present conditions produce most of the ophthalmia seen in the hospital out-patient room. For my own part, I can see no reason against allowing midwives to use, under these circumstances, the 1 per cent. solution of silver, provided, of course, that they have been taught how to apply the medicament. Indeed, we have no choice in the matter. If ophthalmia is ever to be extirpated, prophylaxis must be confided to midwives, who attend, and will doubtless continue to attend, a majority of the labours among the very class where precautions should be most rigorously adopted.

The present regulation of the Central Midwives Board (February, 1907), as pointed out before, allows the women under its control—that is to say, all certified midwives in England and Wales*—practically a free hand. The rule runs as follows: “*As soon as the child's head is born, and if possible, before the eyes are opened, its eyelids should be carefully cleansed.*” The admonition is excellent so far as it goes, but, in my opinion, it does not go nearly far enough, more especially when applied to women in the lower classes. In Prussia and elsewhere the midwife is enjoined to employ the Credé plan with the 2 per cent. solution of silver nitrate. I fail to see why in this country we should not have the courage of our opinions, and instruct the midwives to apply to each eye, after careful preliminary cleansing of the

*The Midwives Act, 1902, does not extend to Scotland or to Ireland.

eyelids, a single drop of the 1 per cent. solution of silver nitrate. No harm could possibly be done, even by an inapt use of the liquid, and for that matter midwives would speedily learn how to use it in a clever and efficient way.

I am of opinion, also, that the Central Midwives Board should promulgate a specific instruction to the effect that on an infant's eyes showing any discharge or redness or swelling of the lids within the first fortnight after birth, the fact should be at once brought under the notice, in writing, of the local supervising authority of the district—*i.e.*, the council of a county or county borough acting or not by committee or by district council—where she pursues her avocation, with a view to professional advice being obtained forthwith. I regret to say I have known of cases where supposedly qualified midwives have not only dissuaded parents from sending a case of ophthalmia to hospital, but have even attempted to treat the disease themselves. My experience is not singular. These practices, I submit, should be suppressed with a strong hand. The profession requires it, and the public (when once it knows the facts) will demand it.

Medical practitioners, of course, will continue to employ whatever means are best calculated, in their experience, to prevent ophthalmia. The real *crux* of the question, as it seems to me, is as to prophylaxis in regard to the offspring of the well-to-do classes. Gonorrhœa, of course, is no respecter of persons, and we all know that the disease occurs, although, doubtless, not so frequently, among the upper as well as among the lower classes of society. This statement is amply warranted by the figures quoted on an earlier page. When we reflect that a man may acquire the disorder in youth, may marry as a young man, and may produce an infected baby in middle age, the difficulties of the situation become aggravated. That such cases occur must now be accepted as a fact. McMunn's case, where a man infected his wife with gonorrhœa 15 years after he had himself contracted the disorder, and Gayet's case, where the interval between infection in the father and ophthalmia in the baby amounted to 10 years, have already been mentioned. An even more remarkable case was that of F. C. Valentine (*Philadelphia Medical Journal*, July 8, 1899), the main facts of which were as follows: a man acquired gonorrhœa when aged 18 years, a

disease that underwent apparent cure. He married at 24 years —i.e., six years after getting the disorder. His wife bore him two children, both of whom were in good health. The woman was then seized with pains in the abdomen, and a few weeks later it was found necessary to remove her ovaries, "which had rapidly become large cysts," in which gonococci were found in abundance. Meanwhile, the husband himself was discovered to have similar micro-organisms in his prostatic fluid. Here, then, was a man free for 30 years from signs or symptoms of gonorrhœa, and yet he infected his wife after 24 years' cohabitation. The woman was presumably able, had events been favourable, to pass on the *materies morbi* to a baby's eyes.

Cases such as the one just quoted, although perhaps not common, go to show that prophylaxis has no right to be neglected, no matter to what class in society the parturient woman may belong. One difficulty is to convince certain members of the medical profession of the necessity of this precaution. A practitioner may have attended hundreds of confinements among the better class without once having seen a case of gonorrhœal ophthalmia. It is naturally not easy to convince a man with that experience of the need for universal prophylaxis. It nevertheless exists! "It has been my lot in the past few years," wrote A. E. Prince (*Medical Record*, August 26, 1903), "to see eyes lost from ophthalmia, in which the mothers were wives of clergymen, merchants, and farmers, who have never been suspected, but in whose cases the development of purulent ophthalmia in the eyes of the infant is the best evidence of the existence of at least a malignant leucorrhœa." Lucien Howe (*American Journal of Ophthalmology*, August, 1897) discussing the objections likely to be raised by such a practitioner, somewhat trenchantly said:— "The evident reply is, that either his experience has been exceptionally fortunate, or that the bad results have been omitted or forgotten. The blind asylum too often has records of his cases."

The 1 per cent. solution of silver produces practically no reaction as regards the conjunctiva, and to me it would appear to be the simplest thing possible to use it as a routine measure to the eyes of all babies, irrespective of the social sphere into which they might happen to be born. Under any circumstances its employment would be imperative if the

practitioner entertained the least suspicion of a gonorrhœal infection in either the mother or the father of the baby. When all is said and done, we do not limit the advantages of the antiseptic system to the poorer classes, and it is difficult to see why, save on the score of a purely sentimental objection, we should confine the use of a modified Credé method to poor people alone.

If the practitioner decide against safeguarding the baby by employing the silver drops, then he must at least cleanse the eyelids with exceeding care as speedily as possible after the head is born. For this purpose cotton swabs, moistened with sterile water, boric lotion, or some non-irritating fluid of the kind, should be employed. The infant's hands should next be carefully freed from extraneous material. The cord is then to be ligated. The face should be washed in water separate from that used for the rest of the body, and on no account must any of the water of the first bath be permitted to come into contact with the baby's face. Finally, after the bath, the infant's eyelids should be again cleansed with pledgets of damp, aseptic cotton wool. Abundant evidence has been brought forward in the course of this communication to prove that the simple precautions described above, are by themselves capable of reducing ophthalmia almost to a vanishing point. The weak point is that they will assuredly fail to prevent the disease if infective material has chanced to reach the conjunctival sac before the eyelids are cleansed. This slight risk must, however, be faced.

It might be thought that medical practitioners needed no instruction as to the ways of preventing ophthalmia neonatorum, and doubtless the majority do not. There remains, however, the significant fact that all the babies, who subsequently develop ophthalmia, have not been delivered by midwives or uninstructed women. That is far from being the case, as every hospital surgeon is aware. W. O. Moore (*Medical Record*, September 30, 1879) brought a terrible indictment against the medical profession when he wrote, "Of 500 cases treated at the New York Eye and Ear Infirmary during the past ten years, only 50 were delivered by midwives; the others were under the charge of practitioners of medicine." "Thus, in the majority of cases," he continued, "the neglect can be traced to the physician in attendance." Moore penned his charges some twenty-eight

years ago, and there are substantial reasons for believing that things are better nowadays, at all events in Great Britain. The proper care of the baby's eyes at birth is now a point inculcated by most of the text-books on midwifery, and teachers of obstetrics do not deem it beneath their notice when lecturing to students. The rising generation of medical practitioners will be better equipped in this respect than were their predecessors. Granting all this, far too many cases of ophthalmia still occur in confinements attended by medical men. H. A. Francisco (*New York Eye and Ear Infirmary Reports*, January, 1895) in a list of forty cases of ophthalmia neonatorum, found that the labour had been conducted in 19 cases by medical practitioners and in 21 by midwives. "Hardly a case," he remarked, "was correctly treated before coming to the infirmary." On reference to my own notes, I find that of 62 cases of ophthalmia neonatorum seen in hospital patients, a medical man had been in attendance upon the mother in 37—that is, more than one half. Some of the cases were doubtless instances of so-called secondary (B) infection, for which no practitioner can be blamed, but others were not. Medical men, too, are now and then responsible for delaying a resort to skilled treatment. Not once, but on several occasions have I been informed that a practitioner has prescribed breast milk, or some more or less inefficient lotion, for a grave case of gonococcal ophthalmia. To quote from a recent communication by E. Treacher Collins (*Practitioner*, 1902, Part I, p. 440), "sad to relate, cases in which delay in the application of appropriate treatment has resulted in permanent damage, are met with where the mothers have been attended by a duly qualified medical man, and not by an ignorant midwife." F. Park Lewis (*Journal American Medical Association*, April 28th, 1906) has recently stated that "the medical profession is by no means yet universally familiar with the facts concerning infantile ophthalmia, as to its prevalence, its dangers, its prevention, and the measures that may be successfully instituted for its treatment."*

*In a more recent communication (*New York State Journal of Medicine*, April, 1907), the same writer has said: "So long as half the births are attended by partially trained midwives, and many more by not over careful physicians, one thing is necessary: the widest dissemination of information as to the importance, the danger, and the prevalence of infantile ophthalmia."

To be efficient, the prophylaxis of ophthalmia should extend over the entire puerperium. It is only by such means that secondary (B) infection of the infant's eyes can be avoided. The precautions to be taken to avoid inoculation of the baby's eyes with infective lochia*, which is probably most dangerous during the first ten days after confinement, should be most carefully explained to the mother. The necessity of the most scrupulous cleanliness should be forcibly impressed on both nurse and mother. The baby should be taken into the mother's bed only for purposes of nourishment. In a word, the environment of the infant and mother should be made as aseptic as though both were recovering from a serious surgical operation.

Summary.

The position may be summed up in a few short sentences. Certain chemical agents, especially the 1 per cent. solution of nitrate of silver, and corrosive sublimate, 1 : 4,000, have been shown to be as efficient in preventing ophthalmia as they are free from anything approaching serious irritation. These harmless remedies should, in my opinion, be employed to the eyes of every baby born in a public institution, whether it be a maternity hospital or a poor-law lying-in department. They should also be used in the extern departments often attached to the maternities and to the large general hospitals in London and elsewhere. Inasmuch as it is admitted that gonorrhœal infection may exist in women without obvious signs, and inasmuch as it has been proved that infection of the baby's eyes is usually the outcome of such a latent, residual, or chronic malady, the conclusion is both inevitable and logical that similar methods of prophylaxis should be applied to the eyes of every child, altogether irrespective of the social standing of its parents. Considerations of expediency, however, unfortunately block the way. If the 1 per cent. silver or corrosive sublimate be not employed, the greatest attention must at least be paid to purifying the vulva, to cleansing the skin of the eyelids with sterile or anti-septic fluid, to keeping the baby's uncleaned hands from his eyes, and to preventing the face from coming in contact with the water used for bathing the body. If there exist the least suspicion of infection (maternal or paternal), or if former

*In institutions it is wise to separate women known to have infective lochia from the others, inasmuch as it is very difficult to prevent the women from fondling one another's babies. The babies of the women known to suffer from ante-partum discharge, at least, should occupy separate cots.

babies have suffered from ophthalmia, the silver or corrosive sublimate should invariably be applied to the infant's eyes, in addition to the other steps detailed above. The most careful attention must be paid to cleanliness during the entire period the woman is confined to bed. Briefly, systematic and continuous prophylaxis is the only efficient safeguard against ophthalmia neonatorum. Antisepsis in the lower classes and asepsis in the upper, represent what can be accomplished without danger in the one case or difficulty in the other.

Supplemental Measures.

A few other points may be briefly discussed, since some of them, at least, are closely concerned with the prevention of ophthalmia. They include:—1. The obligatory notification of the disease. 2. The instruction of medical students and of midwives in the disease. 3. The education of the public as to the dangers of ophthalmia in babies. 4. The appointment of an ophthalmic surgeon on the staff of every maternity hospital. 5. The keeping, and, if possible, the periodical publication, of records with regard to ophthalmia in all public institutions. 6. The gratuitous distribution of an efficient solution for prophylaxis.

1. *The Notification of Ophthalmia.*—That cases of ophthalmia neonatorum should be included in the list of notifiable diseases is no new suggestion. It is one that has been repeated from time to time by many writers, myself included (*Ophthalmia in Newly-born Children*, London, 1898). The plan is actually in force in certain countries, such as Switzerland, Germany, Austria, France, and many of the States of North America. In the case of qualified midwives in England and Wales the notification should be, I think, to the supervising authority of the district in which she works. In other cases, as where the labour is looked after by a non-qualified woman, acting otherwise than under the direction of a qualified medical practitioner, etc., the notification should be to the medical officer of health for the district, or to the authority under which he acts. Under any circumstances, the notification should be made within a certain number of hours after appearances of inflammation have been observed in the baby's eyes. Failure to comply with the law should entail an adequate penalty, monetary or otherwise, and in the case of qualified women, action by the Central Midwives

Board, after investigation (as enjoined by the Act) by the local supervising authority. Since no special provision exists for the treatment of ophthalmia neonatorum, it has been argued that the compulsory notification of the disease would lead nowhere. In my opinion, this is a mistaken view. N. B. Harman (*The Conjunctiva in Health and Disease*, 1905, p. 116) has suggested that a small special hospital, with adequate nursing staff, should be provided in each county for the treatment of cases, the numbers of which could not be great. I am not convinced that this would better matters, unless compulsory hospitalisation was conjoined with compulsory notification. A simpler plan in the case of very poor parents on the verge of pauperism would be the transfer of *both mother and child* to the temporary care of the poor-law authorities, which might reasonably be required to make suitable provision for such cases. Mothers of somewhat better social class, unable to provide adequate medical and nursing attendance for the baby, might still be transferred, as in the case of zymotic ailments in London, to the parochial authorities. Apart from all this, notification, even without hospitalisation, would not be devoid of tangible advantages to the community at large, inasmuch as a responsible officer would visit the house, and make it his business in the case of poor people to see that medical treatment of an adequate kind was obtained, through the parish or otherwise. That notification would imply a slur on the parents' morality might be urged if ophthalmia resulted exclusively from a gonorrhœal infection, but that, as elsewhere shown, is not by any means invariably the case.

2. *The Instruction of Medical Students and of Midwives.*—

It goes almost without saying that students in their hospitals and midwives in their maternities should be given practical instruction as regards ophthalmia, and particularly the means of preventing it. Every text-book of midwifery, whether for students or for midwives, should include an account of the disease, together with clear directions as to prophylaxis. In Great Britain, at all events, great strides have been made in the desired directions during recent years.*

3. *The Education of the Public.*—In 1885 a deputation

*Writing in the year 1885, David McKeown (*Trans. Obstetrical Society of London*, vol. xxvii., p. 52) said: "I have examined a considerable number of the principal text books on midwifery published in this country, and I find that ophthalmia neonatorum is not even mentioned."

from the Ophthalmological Society of the United Kingdom endeavoured to induce the President of the Local Government Board, represented by Mr. George Russell, M.P., Parliamentary Secretary, to sanction the distribution by the registrars of a simple notice pointing out the dangers of ophthalmia neonatorum to everybody registering the birth of a baby. The notice was worded as follows:—" *If the child's lids become red and begin to run with matter within a few days after birth, it is to be taken without a day's delay to a doctor. The disease is very dangerous, and if not at once treated may destroy the sight of both eyes.*" The Government, however, did not see their way to comply with the recommendation of the Ophthalmological Society, mainly on the score of expense. The Registrar-General (who was present during the interview), on the basis of there being 880,000 births registered annually, estimated that no less a sum than £7,334 would have to be paid in extra fees to the registrars for their work in distributing the notices. This and other considerations led him to the conclusion that the proposal made by the Ophthalmological Society was not a practicable one. And there the matter has rested ever since!

What the Government professed itself unable to do has, nevertheless, not proved beyond the powers of certain enlightened corporations, as, for example, that of Glasgow. Cautionary notices have for several years been distributed by the Glasgow registrars, without charge or fee, to everybody who registers the birth of a baby. The circulars are printed at the expense of the Corporation of Glasgow. Something of the same sort, so I am informed, is done at Bradford. At the Sheffield Infirmary a notice concerning ophthalmia is given to everybody who brings a baby labouring under that ailment. A similar plan is adopted at some other hospitals.

It appears to me that the time has come when the President of the Local Government Board might, with advantage, be again approached for the purpose of getting a caution concerning ophthalmia neonatorum systematically distributed both by the poor-law authorities and by the registrars of births and deaths,

*A Bill for the Early Notification of Births is now under the notice of Parliament. The Bill, which is, unfortunately, an adoptive instead of a compulsory measure, provides that notice shall be given to the Medical Officer of Health at his office or residence within thirty-six hours after the birth (*Brit. Med. Jour.*, June 29, 1907, p. 434). If this Bill pass into law, one argument raised against the distribution of notices by Registrars will fall to the ground.

so that every class in the community might ultimately be reached. The Postmaster-General, also, might be induced to allow notices to be displayed in the offices under his control. The occasion is more favourable at the present time than it was in 1885, since, in the interval between then and now, the Royal Commission on the Blind, the Deaf, and the Dumb, etc., has recommended that information about the ailment should be circulated by the sanitary authorities or through the post office. No action, however, has been taken, although there would seem no reason why this should not be done, save on the score of a somewhat paltry and cheese-paring economy. It amounts to this—that we grudge the expenditure of a poor £7,334 per annum, when the commonwealth is losing yearly upwards of one-third of a million sterling by reason of individuals disabled by the ravages of ophthalmia in infancy. The policy under which this is possible can only be characterised as a paltry and short-sighted one.

Whatever the means adopted, it is most desirable that the public should be instructed in the dangers to sight attending untreated ophthalmia neonatorum.

4. *The Appointment of Ophthalmic Surgeons on the Staff of Maternity Hospitals.*—This recommendation was originally made by A. Pinard in a report on the prevention of ophthalmia neonatorum presented a few years ago to the French Academy of Medicine (*Ann. de Gynéc. et d'Obstét.*, January, 1902). The advice has been endorsed by subsequent writers, notably by E. Treacher Collins (*Practitioner*, 1902, Part I, p. 442). In this country, such appointments have been made at Queen Charlotte's Hospital, London, the Rotunda Hospital, Dublin, and the Maternity Hospital, Glasgow.

5. *The Keeping of Proper Records.*—One way of keeping the subject of ophthalmia, as it affects babies, perpetually under the notice of medical men engaged in public institutions where women are brought to bed, is by insisting that proper records shall be kept of the disease. Under the present arrangements (or, rather, the lack of them), it is astonishing how difficult it becomes to obtain trustworthy statistics regarding the disease in Great Britain. Yet the material is abundant! The only important maternities for which such figures are available over a term of years appear to be Queen Charlotte's Hospital, London, the Rotunda Hospital, Dublin, the British Lying-In Hospital, London, the City of London Lying-In Hospital, and the

Clapham Maternity Hospital. For my part, I am convinced that records of ophthalmia neonatorum should be made with the same care as is now devoted, say, to the kind of presentation, the progress of the labour, the condition of the placenta, and the course of the puerperium. It is almost impossible to exaggerate the value of such carefully-kept records. Take, for instance, the action of the Local Government Board in the year 1896, when Dr. Arthur Downes, medical inspector for poor-law purposes, issued to all medical officers in the Metropolitan district a memorandum containing extracts from the recently-published Report of the Royal Commission on the Blind, etc. An opportunity was further taken of recommending that the "medical officer should furnish each midwife or nurse acting under his directions with such written instructions as he may deem necessary to give effect to these recommendations of the Royal Commission." "It is important also," the circular continued, "that he should duly record in his medical relief list every case of ophthalmia of the new-born which may come under his care, and that the 'state' or 'termination' of each case should always be entered in the column provided for that purpose." The simple issue of this official circular at once focussed attention on ophthalmia neonatorum, and led to the adoption in most of the poor-law lying-in departments of means for preventing ophthalmia. The result has been already stated, namely, that the prevalence of the disease in the London institutions has in the course of a single decade been reduced by at least one-half.

6. *The gratuitous Distribution of an efficient Solution for Prophylaxis.*—It has been suggested by F. Park Lewis (*Journal American Medical Association*, April 28, 1906), that an efficient liquid be prepared by some public authority, and be distributed, free from charge, to every obstetrician, physician, or midwife qualified to care for the parturient women. It should be enclosed in a light-proof glass receptacle, arranged so that the fluid might be used drop by drop. As to the particular agent for distribution, Lewis points out that silver nitrate is at once the cheapest, most effectual, and most permanent at our disposal. At present in England we do something of the kind with regard to calf lymph and antitoxin. The principle involved in Lewis's proposal is therefore already conceded.

TREATMENT.

I. Gonococcal Ophthalmia.

In gonorrhœal ophthalmia the obvious indications are two in number—first, to destroy the gonococci and associated micro-organisms by the local employment of such chemical agents as do a minimum of mischief to the mucous membrane ; and, secondly, to keep the eyes free from infective secretions by the use of non-irritating fluids, antiseptic or otherwise. Some importance is now likely to be attached to a third indication, namely, the employment of anti-toxic or anti-microbial sera.

The germicidal agent which until recently has occupied the field, to the exclusion of almost every other remedy of the kind, is nitrate of silver, which was used empirically in the treatment of ophthalmia neonatorum for long before the cause of that disease was understood. Its position until recently was unassailable. The routine treatment in this country, as well as in others, consisted in the application to the inflamed conjunctiva, once or twice in the twenty-four hours, of a solution containing five, ten, or fifteen grains of silver nitrate to the ounce of distilled water. The eyelids were, if possible, everted, so as to expose their mucous lining, and after this had been freed from pus, the solution was carefully applied to every accessible part of the conjunctiva. Many surgeons were in the habit of neutralizing any excess of silver by after-washing with a solution of common salt. In severe cases, where eversion of the eyelids was impossible, or could be accomplished only at the expense of pain and of risk of damaging the cornea, the solution was applied—first, to the lower lid, and, then, some of the liquid was allowed to run into the eye.

Nothing need be said as to that relic of a less scientific period, namely, the direct medication of the palpebral conjunctiva by means of a stick of silver nitrate, mitigated or otherwise. This method, barbarous in the extreme, set up great pain and swelling, produced sloughs of the mucous membrane, and was, in my opinion, calculated to make things worse rather than better.

There exists not the least doubt in the mind of any experienced surgeon that treatment with solutions of silver nitrate

is most efficient. The application, however, entails certain disadvantages, of which the most important are pain, caustic and escharotic action, want of penetration, and a chance that in unaccustomed hands the full benefits of the remedy are not obtained. These, together with some minor disadvantages, led to the substitution for silver nitrate of certain synthetic preparations of silver, among the more notable of which may be mentioned protargol and argyrol. It was claimed that these new agents possessed marked bactericidal powers (especially against the gonococcus); that they did not coagulate albumen and hence had considerable powers of penetration; and, last but not least, that they caused no pain, even when freely applied to the diseased conjunctiva.

At the present moment we have the somewhat unedifying spectacle of two opposing schools, of which one utterly condemns all synthetic compounds of silver, while the other wholly excludes silver nitrate as a means of treating ophthalmia neonatorum. Extreme views of this description, which are usually based upon as scant evidence in the one case as in the other, can convey little conviction to an unbiased mind. It is likely, indeed, that truth, as usual, lies somewhere between the conflicting claims.

In view of the latest laboratory reports, it appears that the bactericidal powers formerly claimed for one of the newer silver compounds must be considerably modified. It was thought that their antiseptic virtues stood in direct ratio to the percentage of silver contained by them (Sigmund Fraenkel). It has been found, however, that this view is based upon insufficient data. Marshall and Neave (*British Medical Journal*, Aug. 18, 1906), who made extensive researches into the subject, concluded that while silver nitrate and protargol were powerfully bactericidal, argyrol and collargol possessed no bactericidal properties whatever. As collargol includes 86·6 per cent.* of metallic silver and argyrol 20 per cent.* it seems clear that the amount of silver which a compound may contain furnishes us with no clue whatever to its bactericidal power. Protargol, readers may be reminded, which has been shown to be a powerful bactericide, includes only 7·4* per cent. of silver. The careful investigations of George S. Derby (*Trans. American Ophthalmological Society*,

*The percentage amount of silver is quoted from the independent analyses made by Marshall and Neave (*loco citato*), and not from the manufacturers' catalogues.

Vol. XI, Part I, 1906) deserve to be mentioned briefly. The object of his investigations was to compare the germicidal power of silver nitrate and some of the newer silver preparations, especially argyrol. For this purpose, he employed cultures of the *staphylococcus pyogenes aureus*. He found that silver nitrate in strength from $\frac{1}{2}$ per cent. to 2 per cent. killed the micro-organism in question in from two to five minutes. The germicidal action of protargol was efficient, although not so efficient as that of silver nitrate. Thus, the organism was usually killed by a 2 per cent. to 4 per cent. solution after an exposure of from three to five minutes. The bactericidal power of collargol was comparatively weak. As regards argyrol, a growth of the *aureus* was obtained after exposure for two hours to the action of 10 per cent., 25 per cent., and 50 per cent. solutions. In the presence of albumen and of urine it yielded a precipitate, although the opacity of the solution tended to disguise the fact.

Derby suggested that the disappointing results obtained by the use of all silver bactericides in gonorrhœal affections might be due to the protective action of blood-serum in living tissues.

The laboratory obviously cannot reproduce the conditions of the human body, even roughly. When all is said and done, the supreme test of the action of a given remedy is to be made in actual clinical work. As Derby himself has said: "Great care must always be taken in drawing practical conclusions from laboratory evidence alone." The question, after all, is one that every practitioner must settle for himself by the actual results of his clinical experience. Laboratory results, however positive in appearance, should be accepted only by a mind open to the possible sources of fallacy, which from the very nature of things are numerous and almost unavoidable. As regards argyrol, assuming that it possesses little germicidal power, it simply means that its well-authenticated clinical activity is due to some other property, not yet disclosed by the microscope and the culture-tube.

Speaking for myself, I have employed protargol and argyrol, almost from their introduction into practical medicine, in many cases of gonococcal ophthalmia, and I have formed and continue to hold a favourable opinion as to the efficacy of both remedies. Writing in the year 1898 (*Ophthalmia in*

Newly-Born Children, p. 27), at a time when my experience of protargol was on a comparatively small scale and before argyrol was introduced (*Medical Record*, May 24, 1902), I said: "It seems likely that protargol, at all events, may prove really useful in the treatment of ophthalmia. My experiments show that it acts well, while it is almost devoid of irritating properties, even when dusted over the conjunctiva. At the same time, so formidable are the results of a badly-treated ophthalmia that I hesitate to recommend anything that has not stood the test of many years' trial." Two years later, however, my mind was made up with regard to the value of protargol in the disease. In the course of a communication published in the *Edinburgh Medical Journal*, of March, 1900, I recounted my experiences in the following words:—"My first experiments were made with rather weak solutions of protargol, namely 2 per cent. to 10 per cent. The exposed conjunctiva was brushed once daily with the solution, while at the same time the mucous membrane was kept cleansed with weak antiseptic lotions. Under that plan cases did fairly well; the discharge became thinner and less in quantity; the swelling of the lids subsided; and corneal complications seldom occurred. But, on the whole, protargol seemed to me at that stage to possess no very marked advantage—beyond the lessened painfulness—over the 2 per cent. solution of argentic nitrate, commonly used in ophthalmic practice. I then commenced to increase the strength of the solutions, and for several months past I have used a 50 per cent. solution, with which I do not hesitate to treat the conjunctiva in severe cases twice within 24 hours. As a result of this experience, I can now definitely say that in my hands protargol has given better results in the treatment of gonococcal conjunctivitis than any other silver salt with which I had been previously acquainted. The presence of corneal complications is no contraindication to the use of the strong solution of protargol. On the contrary, the existence of such ulceration is an additional reason for pushing the protargol."

My position with regard to protargol is the same to-day as it was when I wrote in 1900, although for the past three years I have employed argyrol, I must confess, almost to the exclusion of protargol.

From a purely clinical standpoint, I now invariably employ a 25 per cent. solution of argyrol to commence with. It is applied to the conjunctiva, according to the severity of the symptoms, once, twice, thrice, or even four times in the 24 hours by a medical man or nurse skilled in such matters. If a decided impression be not made upon the disease after a few days' (3 or 4) treatment, I never hesitate to resort to silver nitrate, $\frac{1}{2}$ per cent., 1 per cent., 1.5 per cent. or 2 per cent., according to the stage of the malady. The more profuse the suppuration, the stronger do I use the silver. A corneal ulcer, not healing under argyrol or protargol, furnishes me with another very definite indication for silver nitrate; and so does any appearance of the parts indicating that the condition is likely to become subacute or chronic. An advantage that both argyrol and protargol have over silver nitrate is that either may be applied, without danger, at the earliest stage of the disease, and, especially, that they may be entrusted to the baby's friends for home use. It is better to apply the remedy as described above, but if that be not possible, the friends may be allowed to drop the solution into the baby's eyes, after they have been freed from discharge, as often as thought desirable by the practitioner. Argyrol is absolutely unirritating, nay, actually soothing, to the inflamed tissues. Like protargol, it should be freshly prepared with *cold* water, and be kept away from light. Stock solutions should be most carefully avoided.

Standish's recent figures with regard to the results obtained in ophthalmia neonatorum with silver nitrate, protargol, and argyrol are striking (*Trans. Amer. Ophthalmological Society*, 1906, p. 16), and deserve to be carefully pondered by those who continue to decry the newer preparations of silver. Briefly, 50 cases of ophthalmia which were received with clear corneæ were treated with silver nitrate, and 3, or 6 per cent., were subsequently infected; 150 cases, under similar conditions, treated with protargol, showed 3 infections, or 2 per cent.; and 201 cases treated with argyrol, showed 4 infections, or 1.99 per cent. These important figures are embodied in the following table:—

Remedy.	Number of Cases Treated.	Number of Corneal Infections.	Percentage of Corneal Infections.
1. Silver nitrate ...	50	3	6.00
2. Protargol ...	150	3	2.00
3. Argyrol ...	201	4	1.99

What has been called the "immersion treatment" has recently been advocated by Standish and by Bruns (*Trans. Amer. Ophth. Society*, 1906). It merely consists in the very frequent application, every 15 or 30 minutes, to the inflamed conjunctiva of a 10 per cent. or stronger solution of argyrol. This is merely an elaboration of a plan proposed by Adolf Alt (*American Journal of Ophthalmology*, April, 1901), who employed a 1 per cent. to 3 per cent. solution of protargol, which he dropped into the conjunctival sac from four to eight times in the 24 hours. Pfalz (*Zeitschrift für Augenheilk.*, Bd. XIII, March, 1905) also insisted that protargol must be applied often if its full activity was to be obtained.

Both protargol and argyrol (particularly the former) may stain the conjunctiva if used for long periods, but that is scarcely likely to be the case in ophthalmia neonatorum, where treatment lasts for a few weeks at the outside. E. N. Neeper (*Ophthalmic Record*, 1905, July, p. 354) has reported two cases of ophthalmia neonatorum in which the use of 50 per cent. argyrol was followed by congestion of the nasal mucous membrane, together with profuse whitish nasal discharge, with dark specks of precipitated silver in the vomit of one baby and in the stools of the other. Since adrenalin had also been employed, it was thought to have rendered the lacrymal passages patulous, and thus to have allowed the argyrol to pass freely into the nose. Neeper's curious observation furnishes us with additional testimony to the powerful penetrative powers of argyrol. In older subjects it is common to hear complaints of the silver staining the handkerchief after argyrol has been applied to the conjunctival sac, and it is not uncommon, if post-nasal catarrh exist, to observe stains of silver in the mucus on the back of the patient's naso-pharynx.

In the intervals between successive brushings with argyrol, protargol, or silver nitrate, the eyes must be kept clean by the use (day and night in severe cases) of some weak and

non-irritating lotion, of which many are available. For my own part, I prefer oxycyanide of mercury (1 : 4,000), or permanganate of soda or potash (1 : 2,000); but the last-named, although effeaeious, has the slight drawback of staining both fingers, face, and garments. Other non-irritating fluids are normal saline solution, boric acid (3 per cent.), naphthol (1 : 5,000), and sterile water. Sublimate (1 : 6,000 to 1 : 10,000) is employed by many surgeons.

Whatever the particular medicament selected by the surgeon, it should be used warm, and applied to the conjunctiva, exposed by eversion of the lids, if possible, with a pledget of absorbent wool. The greatest care must, of course, be exercised not to damage the cornea. Personally, I am opposed to the use of syringes, except in experienced hands. It is doubtless a simple matter to cleanse an eye with these appliances, but, then, it is almost equally simple to do harm with them. In an eye with gonococcal ophthalmia, a minute abrasion of the cornea, such as may be readily brought about by the least carelessness in the use of a glass syringe, may admit septic micro-organisms and thus lead to loss of the eye. There is another objection to the use of a syringe, *viz.*, the risk of fluid spurting into the nurse's eye, a casualty that has taken place several times within my own experience. In Wray's modified syringe the glass nozzle is replaced by one constructed of soft rubber tubing. This simple device certainly renders the syringe less liable to abrade the cornea, but at the same time it does not ensure against the danger of inoculating oneself by accidental spurts of matter. Nurses in out-patient departments (upon whom the routine duty of treating these cases seems usually to be cast) are fond of cleansing the eyes of ophthalmic babies with the glass bottle commonly called an "undine," invented by a Philadelphia pharmacist, named Llewellyn (*Ophthalmic Record*, Vol. 3, 1893, p. 434). If the use of this little appliance be sanctioned at all (the advisability of which I doubt), its nozzle should at all events be furnished with a short length of rubber tubing, in order to make it as safe as may be.*

*One of the best ways of getting rid of discharge is to use hydrogen peroxide, perhydrol (Merck), to the eyes. This non-toxic liquid decomposes the pus, with evolution of gas, and allows the *dibris* to be washed away readily with any of the ordinary lotions. The same liquid has recently been used by A. Bronner (*Trans. Ophthal. Society*, Vol. XXIV, 1904, p. 30) with success in the treatment of gonococcal ophthalmia in an adult. The treatment, however, is an old one.

Aside from the actual means employed, in severe cases of ophthalmia neonatorum the pus must be removed almost as soon as it forms, which is much the same thing as saying that the baby, during the height of the disease at all events, must be tended day and night. In private work this implies a couple of nurses, one for day and the other for night duty. In this ailment, perhaps more than in any other, a great deal depends upon the care and loyalty with which the attendants carry out the practitioner's instructions.

Iced applications to the eyelids still enjoy some favour on the continent of Europe, but in England, at all events, one seldom hears of their employment in cases of ophthalmia neonatorum. They are troublesome to manage properly, and can indeed scarcely be carried out, except in the most perfunctory way, in the homes of the poor—that is to say, where the cases are usually treated. The idea underlying this plan of treatment is that the temperature of the conjunctival sac should be kept below the point at which the gonocoecus is known from experiments in the laboratory to thrive. From certain experiences, mentioned earlier in the course of the present communication, this seems to be possible. There is, however, evidence that tends to prove that corneal affections are not less common in gonococcal ophthalmia when ice is used than when the case is treated in the ordinary way. Thus, Myles Standish (*Journ. Amer. Med. Association*, December 17, 1904) has furnished us with the figures quoted below with regard to this crucial point:—Of 17 cases admitted with clear corneæ where iced applications were made, 10 were discharged without corneal lesions—i.e., 59 per cent. successful cases. During the same period, of 38 cases admitted with clear corneæ, and treated without cold, 28 were discharged without corneal lesions—i.e., 74 per cent. successful cases. It should be said, however, that the cases of gonorrhœal ophthalmia, analysed by Standish, all occurred in patients upwards of five years of age. E. L. Meierhof (*New York Medical Journal*, November 30, 1901), has reported two cases of clouding of the cornea in infants, due, in his opinion, to the application of ice-cold pledges to the eyelids for the purpose of combating ophthalmia. The opacities disappeared when warm were substituted for cold applications.

Reference should be made to a plan of treating ophthalmia neonatorum that has lately become rather prominent, especially in France. I refer to the method, re-introduced by Kalt (*Archives d'ophtalmologie*, T. XIV, 1894, p. 780), of flushing out the inflamed eye, two to four times a day, with some three pints of a solution of potassium or calcium permanganate, 1:3,000, previously warmed to about the temperature of the human body. For this purpose he employs an irrigator, the flexible rubber tube of which is fitted with an ebonite pipe, having an expanded end, shaped something like the mouth of a trumpet. The latter is introduced between the eyelids, and the discharge washed away with the lotion that flows through it. No other treatment is employed. There appears to be no reason why excellent results should not be obtained by Kalt's method, although it seems a little complicated, and must assuredly involve a serious expenditure of time as regards the practitioner, who could hardly permit a nurse to use the apparatus.

The permanganate has been employed by some other surgeons in much greater concentration. For example, Vian (*Société française d'ophtalmologie*, May, 1897) applies once or twice a day to the inflamed conjunctiva a 10 per cent. or even stronger solution. In reference to this treatment it is important to note that the remedy may stain the cornea when the latter is ulcerated, thus causing needless alarm to the parents, unless they have been previously warned. The following case of the kind fell under my notice some years ago :

Case No. 22. —A male child was born at term, after a quick and easy labour, on August 30, 1897. On September 13 the left eye was noticed to be red, and to have yellow discharge running from between the lids. Three days later the parents called in a local practitioner, who directed the frequent use to the eye of a solution of potassium permanganate, estimated to contain at least 15 grains to the fluid ounce. On October 7 the baby was able to open his eyes, the lids of which had before been so much swollen that he could not do so. His mother was then horrified to observe a coal black patch on the lower part of the left cornea, and on that account hurried up to London to consult me. On examination, I found a black, oval area, occupying the lower third of the baby's left cornea. The appearance reminded one of what is seen when the iris is torn away from its ciliary attachment. The curious mark, however, clearly lay in the cornea, and I concluded that it was nothing more than a deposit of the manganate upon an ulcerated spot. Gonococci were found in discharge from the conjunctiva. The colour of the blemish soon faded, and the patient eventually made a good recovery. The late infection (14 days after birth) was traced to the baby occupying the same bed as the mother, who was found to be suffering from gonorrhœa.

A similar accident has been commented on by other authors, as Calabet (*Thèse de Bordeaux*, 1903, p. 29), who described a

case of ophthalmia treated with $\frac{1}{2}$ per cent. permanganate, which showed on the tenth day an infiltration of the cornea with the permanganate salt. The mark, as usual, disappeared without special treatment.

The use of the silver preparation should be continued until such time as : (1) the discharge becomes thin and scanty ; (2) the swelling of the lids abates ; (3) the redness of the conjunctiva is reduced ; and (4) the gonococci disappear or, at all events, are found with difficulty. The remedy should then be applied less frequently, say, twice or thrice a week—for a further term. In the residual stages of disease I have found a weak solution (0.5 per cent.) of silver nitrate act better than either argyrol or protargol, doubtless owing to the astringent properties of the first-named agent. Zinc chloride (gr. 1 to the ounce) is also useful under these circumstances.

If corneal complications are not present, cure will, in general, be obtained within a month or five weeks. But since some cases have a tendency to relapse, treatment should never be given up prematurely.

Two kinds of serum have so far been employed in the treatment of gonorrhœal ophthalmia, namely, that introduced by J. C. Torrey (*Journ. Amer. Med. Association*, January 27, 1906, p. 261), and a polyvalent antistreptococcus serum, manufactured by Messrs. Burroughs, Wellcome, & Co., of London. The Torrey serum has been found to contain both agglutinins and precipitins for the gonococcus, and is thought to owe its action to a bactericidal activity. It was used by Cutler (*Annales d'oculistique*, November, 1906, p. 399) in several cases of gonococcal ophthalmia without any very tangible results. It was injected beneath the skin and dropped into the eye, without obvious reaction. The patients thus treated all recovered, but as silver nitrate was also used to the eyes, it is difficult to form a conclusion as to the true value of the remedy. J. P. Parkinson and W. S. Fenwick (*Lancet*, May 5, 1906, p. 1,244) have used rectal injections of an antistreptococcus serum in the treatment of several affections of gonorrhœal origin, such as arthritis and pyæmia. The injection is made as high up the rectum as possible by means of a urethral syringe, on to the nozzle of which a soft rubber catheter has been fixed. The

first dose is 20cc., followed by two doses, each of 10cc., every other day, thus making in all three injections. The plan is simple and free from danger. It has seemed to me to be useful in the few cases of gonococcal ophthalmia where I have tried it, in conjunction with the more ordinary measures. It is, however, difficult to explain why it should act at all on gonococcal processes, pure and simple, although its action can be readily understood on the assumption that one has to deal with a mixed infection. However, something of an analogous kind has been observed in the treatment of hypopyon-keratitis, which is generally due to the pneumococcus, not with antipneumococcic but with the antidiphtheritic serum (Darier's *Leçons de Thérapeutique Oculaire*, third edition, 1907, p. 299 *et seq.*), and Giorelli and Brinda (*Archives de Médecine des Enfants*, December, 1905) have reported cures of streptococcal stomatitis and of gonococcal vulvitis cured by the same serum.

The management of the corneal complications of ophthalmia neonatorum opens up wide, interesting, and most important questions. It has already been stated that these lesions are the most convincing clinical proof as to the gonorrhœal nature of a given conjunctivitis. The fact has also been emphasised that the general condition of the child is closely connected with their causation. The likelihood of corneal mischief, again, in any given case, stands in direct ratio to the degree of chemosis present. It is well to differentiate the early from the late ulcerations, since the former, in my experience, are incomparably the more dangerous. They are observed during the stage of suppuration—that is to say, from about the fourth to the fourteenth day of the disease. The later ulcerations may supervene at any period from the end of the second week until the ophthalmia is completely cured.

Now, if the cornea be hazy or ulcerated when the baby first comes under notice, the routine treatment, in hospital and elsewhere, is to apply three times a day one drop or more of a solution of atropine sulphate, 2 to 4 grains to the fluid ounce, and at the same time to treat the ophthalmia *secundum artem*. This is, in many cases, a singularly perfunctory and inefficient plan, certainly when dealing with the earlier ulcerations. It is likely to succeed only with the later ones. For my own

part, I confess I am unable to understand what influence a solution of atropine can be expected to exert on a progressive and septic ulceration of the cornea. If the avowed object of the medicament be merely to keep the pupil dilated and the iris away from a more or less central ulceration of the cornea, *which the surgeon expects to perforate*, the position is at all events clear. That atropine, however, should be expected, in some unexplained way, to check the progress of an ulcer is a proposition that on the face of it carries no conviction whatever to my mind.

The case is otherwise as regards the local use of physostigmine, a remedy that we recognize to be of signal service in limiting the spread of ulcerations of the cornea due to causes other than ophthalmia, particularly that curious affection of infant's eyes known as keratomalacia. I have personally seen very threatening ulcerations speedily yield to the frequent use of sulphate of physostigmine, 2 grains to the ounce. Under these circumstances, I feel justified in urging that, as a routine treatment for the corneal complications of ophthalmia neonatorum, atropine should yield to physostigmine. Since the corneal inflammation is secondary to the ophthalmia, the treatment of the lids by a preparation of silver should be continued, but care should be exercised to limit the action of that substance, as far as may be, to the mucous membrane, and to apply it with the greatest gentleness. Indeed, anything like rough handling of the parts must be most carefully eschewed.

In my experience, the treatment by physostigmine can be depended on only in the milder cases, especially in those where the baby's general condition is satisfactory. On the other hand, if the ulcer be deep, or if its edges be yellow, or if there be pus in the anterior chamber, or if the baby be marasmic, then more active measures must be promptly taken if the eye is to be saved. The simplest, although by no means the most efficacious, plan is to paint the diseased parts with the *acidum carbolicum liquefactum* of the British Pharmacopoeia, and to repeat the process, if necessary, on several occasions. The immediate result of this procedure is to make the parts touched by the acid look as if they had been coated with white oil paint, but this appearance soon passes away. Meanwhile, treatment of the case by silver, etc., should be kept up, but the eye should not be bandaged, I think, unless a perforation of the cornea appears to be imminent.

By far the most trustworthy treatment of the really severe cases, in my experience, is to anæsthetise the baby, to insert a speculum between the lids, to remove all traces of discharge with perhydrol, and to apply the galvano- or thermo-cautery freely to the ulcer and especially to its infiltrated edges, first clearly defined by dropping into the eye a solution of fluorescein. After operation, iodoform may be sprinkled over the parts, and in some cases a bandage applied.

By the use of the cautery many an eye is now saved that would once have been doomed to total extinction, a fact that cannot be too widely known in the medical profession. My own work has familiarised me with the happy results that may often be obtained in this way. A few illustrative cases may be briefly recounted :

Case No. 23.—Jane S ——, aged 17 days, admitted in May, 1903, suffering from bilateral gonococcal ophthalmia dating from the third day after birth. An ulcer lay at the junction between the lower and the middle third of each cornea. Despite treatment by protargol and argentic nitrate, the ulcer in the right cornea became considerably larger in the next six days. The galvano-cautery was therefore applied freely. The condition showed improvement almost at once. About 18 months later the leucoma present on the right cornea, which had been operated on, was actually less conspicuous than that on the left. There was no entanglement of the iris in either eye.

Case No. 24.—Kate C ——, aged 5 weeks, admitted to the North-Eastern Hospital for Children, April 21, 1904, on account of gonococcal ophthalmia, which had attacked the left eye on the second, and the right eye on the fourth, day after birth. Fluor albus in mother, whose other two children had not been affected with ophthalmia. A zone occupying the outer two-thirds of the right cornea, was converted into a red, epaulet-like area, while the central third was represented by a greyish slough. It goes without saying that none of the deeper parts of the eye could be recognised. The galvano-cautery was freely applied to the central slough-like area and sparingly over the vascularised portions of the right cornea. Argyrol, 25 per cent., was used once daily to the lids of both eyes. On May 1 a note was made to the effect that the right eye had retained its size and shape, and that the central parts of the cornea were occupied by a leucoma, to the hinder surface of which the iris was adherent. The other parts of the cornea had regained their transparency. Baby discharged on May 12, 1904. The child was last seen on March 21st, 1907—i.e., nearly three years after the inflammation. The right eye (which certainly retained some sight) was convergent 25 degrees. The cornea was clear everywhere except over a small area lying to the inner side of its centre, which was occupied by an inconspicuous adherent leucoma. A tiny white anterior polar cataract was present.

Case No. 25.—Florence K ——, aged 3 weeks, admitted July 14, 1904. The eyes had been inflamed for one week, but no treatment had been adopted except ablutions with warm water. A severe case with tense and swollen lids, some chemosis, and abundant pus, containing gonococci. The right cornea was slightly hazy (positive chemotaxis) with a small, shallow ulceration in its lower-inner quadrant. The left cornea appeared to be totally disorganised : a small keratocele could, however, be recognised in its lower outer quadrant. Baby taken in to hospital, and arrangements made for mother to continue nursing her offspring. Under chloroform, the galvano-cautery was applied to the entire surface of the left cornea. Eyes treated with argyrol (50 per cent.) and potassium permanganate (1 : 5,000). On August 8th, 1904, ophthalmia practically well. No discharge from eyes, which baby opens well. Right cornea quite clear. Left cornea has cleared in

a surprising way, considering its former condition. When the baby was discharged three days later, two-thirds of the left cornea were transparent, the iris was non-adherent, and some clear pupil could be seen.

Case No. 26. Stanley E ——, 6 weeks, admitted December 1, 1904, with unilateral gonococcal ophthalmia, dating from the fourth day after birth. He had been weaned, and, according to the mother's statement, a white "spot" had been noticed over the eye during that process. It was significant that he then suffered from diarrhoea and lost flesh. On examination, the left cornea was wholly opaque, and there was a central perforation filled with whitish-yellow material. The edges of the ulceration were sloughy-looking. Under A.C.E., the point of the galvanocautery was passed into the anterior chamber, and a quantity of pus was in that way evacuated. The case was afterwards treated in the usual way with argyrol (50 per cent.), potassium permanganate lotion, and so forth. On December 8 the ulcer was healing, and the eye looked better in every way. This baby, discharged from the hospital on December 27, 1904, eventually obtained a serviceable eye, although with a small adherent leucoma and anterior capsular cataract.

It would be easy to multiply cases such as those described above, but enough has been said to show that the cautery treatment of severe gonococcal ulcerations of the cornea is capable of yielding excellent results, far exceeding those likely to be obtained by any other plan with which I am personally acquainted.

The general treatment of ophthalmia neonatorum, to which too little attention is sometimes paid, resolves itself mainly into a question of feeding. I am confident, from what I have seen of the cases, that babies do better when nursed than when bottle-fed. The artificially-fed babies, as pointed out before, are particularly liable to corneal complications. Hence, if the baby cannot be nursed, it is worth while to give precise directions with regard to such points as the preparation and sterilisation of milk, the kind of bottle to be used, etc. It has seemed to me that these ophthalmic infants recover more rapidly if fed with diluted peptonised milk than in the ordinary way, although that is a matter on which I feel myself hardly competent to express a dogmatic opinion. When suppuration is at its height, one should be careful in bathing the infant, inasmuch as any undue exposure may chill the baby and exacerbate the symptoms of ophthalmia, as pointed out by Eversbusch (*Centralbl. f. Kinderheilk.*, 1897). As soon as the acuter stages of disease are passed, the baby should be taken out every day into the open air, the eyes being shielded from cold wind by means of a suitable veil.

It has been suggested that when ophthalmia is unilateral, an attempt should be made to prevent infection of the other eye. For this purpose the sound eye has been shielded with a watch glass, as in Buller's plan, or kept covered with some dressing antiseptic or otherwise. It is not, however, easy, and indeed it

is sometimes impossible, to keep anything in place in such young children. Personally, I limit myself to recommending that the baby be made to lie on the side corresponding to the inflamed eye (Dequevauviller), and, occasionally, that the hands be tied together. Cleanliness of the affected eye, together with the daily application of silver nitrate, protargol, or argyrol, will materially lessen the risks of an eye-to-eye infection. I see no objection to the prophylactic use of protargol or argyrol under these circumstances, a drop of 20 per cent. solution being placed once a day into the conjunctival sac of the unaffected eye. Fraenkel (*Klin. Monatsbl. f. Augenheilk.*, 1889, p. 57) recommended the employment of silver nitrate for the same purpose. It is well to know that the second eye, when attacked, seldom suffers so severely as the first. This clinical observation, which I have had many opportunities of verifying, is probably due to an attenuation of the specific virus. The production of a relative immunity seems to be less probable from what we know of the life-history of the gonococcus.

In dealing with ophthalmia neonatorum, it is always necessary to warn those who tend the baby as to the risks of catching ophthalmia. The chances of infection are many, and it is a somewhat singular circumstance that the disease does not spread more often than appears to be the case. I have, however, known some sad instances where it affected those about the infant, and once, as mentioned earlier in this communication, within my own knowledge, it gave rise to an epidemic which involved a large number of children, along with some grown-up persons.* "I have seen," says Fuchs (*Text-Book of Ophthalmology*, 1899, p. 60), "a whole family affected by blennorrhœa by a child having blennorrhœa neonatorum, and thus placed in the greatest misery."

It goes without saying, that the surgeon should be most particular about cleansing his fingers and his instruments both before and after attending to a case of ophthalmia neonatorum. Special care should be taken to avoid spurts of pus from between the baby's eyelids, such as may come about during examination of the eye or the use of a syringe for clearing away discharge.

*The eyes of a baby suffering from ophthalmia should be bandaged before he is nursed by his mother. In this way the risks of infection are materially lessened.

It is comparatively rare for a carefully-treated case of ophthalmia neonatorum to take on a condition of chronic blennorrhœa, characterised by thickening and congestion and relaxation of the conjunctiva, heaviness of the lids, and the persistence of a certain quantity of discharge in which gonococci can seldom be found. This condition, in my experience, is more likely to follow treatment with argyrol or protargol than with silver nitrate, possibly because the former agents lack the astringency possessed by the latter. Such cases, I believe, usually mean a secondary inoculation with the Morax-Axenfeld diplobacillus, and are best treated with a solution of zinc chloride, gr. $\frac{1}{2}$ to gr. $1\frac{1}{2}$ to the ounce of water, applied to the eyes three times a day or oftener, according to the nature of the symptoms that are present, or by silver nitrate. Cupro-citrol,* also, is a remedy by no means devoid of value, especially in reducing thickening of the palpebral conjunctiva. A small piece of the salve should be put into the conjunctival sac night and morning.

2. Non-Gonococcal Ophthalmia.

The milder forms of ophthalmia—that is to say, those not associated with the gonococcus—are best treated with one or other of the lotions mentioned on page 231, applied to the eyes two or three times a day. It is seldom necessary to use a silver preparation in these cases, although there is no particular objection to doing so, especially if argyrol be selected for the purpose. But if the symptoms are severe, more especially if the eyelids be swollen, or the discharge resembles pus, and if an extemporaneous bacteriological examination cannot be made forthwith, the case had better be treated as though it were an instance of gonococcal ophthalmia. By following this advice, no harm is likely to be done, and an eye may sometimes be saved that might otherwise be lost.

Two grave forms of ophthalmia, not due to gonococci, call for treatment by serum, namely, those due respectively to the streptoeoccus and to the Klebs-Löffler bacillus. Both are exceedingly rare. In each case, the appropriate serum should be administered according to rules now too well-known to call for recapitulation in this place.

*Cupro-citrol is a mixture of cupric citrate and the glycerine ointment of the Austrian pharmacopeia. It can be obtained without difficulty in London.

GENERAL CONCLUSIONS.

The generic name *ophthalmia neonatorum* includes several distinct disorders of varying severity.

In the foremost rank stands that form of conjunctivitis associated with the Neisser gonococcus, an ailment usually, but by no means always, characterised by marked signs. Two-thirds of the hospital cases belong to this group, but in private practice the proportion is almost certainly less. So dangerous is this affection that, of those affected, probably one in ten lose one or both eyes, while the cornea is more or less affected in 25 per cent. of the cases. It therefore always calls for the prompt application of suitable remedies. A good prognosis may, in general, be given when (a) the baby is well-nourished and free from inherited disease ; (b) the case comes under care before the cornea is affected ; and (c) there are no local conditions, especially congenital narrowness of the fissure between the eyelids, as in premature infants, that militate against recovery. The treatment should consist in destroying the gonococci locally by the use of antiseptics, particularly by the salts of silver, and in constantly removing infective discharge by the use of a non-irritating fluid. Corneal complications are to be opposed by physostigmine, or, if that fail, by the local application of carbolic acid or, especially, of the galvano-cautery. The last-named should probably be applied in every severe case. Any constitutional ailment, as syphilis, must be attended to. If the baby cannot be nursed, the question of artificial feeding should be carefully gone into. Lastly, the contagious nature of *ophthalmia* should always be explained to those placed in charge of an infant suffering from the ailment.

Then, we have milder forms of inflammation caused by certain other micro-organisms, particularly by the pneumococcus and the colon bacillus. For the most part, these are innocuous enough, and owe their importance to their liability to be confused with the gonorrhœal cases. Among them, however, the rare cases due to the Klebs-Löffler bacillus and to the streptococcus are dangerous, and should be treated as early as possible with the proper serum.

To make a correct diagnosis is to take the first step towards scientific and successful treatment of the case. To

differentiate with certainty between the various forms of ophthalmia, a bacteriological examination is imperative. The methods of investigation, as a rule, are simple, and such as can be carried out by any practitioner, who is possessed of a $1/12$ th inch oil immersion lens and a few reagents, without any great expenditure of time. In most cases it is enough to stain films from the pus. Cultivation tests are called for only now and then.

Repeated cleansing of the vulva shortly before the head is born, together with careful cleansing of the skin of the eyelids as soon as the baby's head emerges is capable of materially reducing the incidence of ophthalmia. But since one can never be certain that pathogenic micro-organisms have not already reached the conjunctival sac, the employment of a germicide is always desirable, although perhaps only necessary in institutions or among the lower class of the population confined in their own houses. In good-class patients, on the other hand, the careful cleansing of the vulva and of the baby's eyelids will probably suffice, unless there is evidence that a gonorrhoeal infection is present or that former children of the same parents have developed ophthalmia neonatorum. Among the various chemical agents employed in the preventive treatment of ophthalmia, the preparations of silver, both inorganic and organic, stand prominently forward. The 2 per cent. solution originally recommended by Credé is an efficient liquid, but, unfortunately, its application to the baby's eye is often followed by so-called "silver catarrh." On the other hand, a 1 per cent. solution of the same salt is rarely complicated with consecutive reaction, and it has been shown in the course of the present communication to possess preventive powers at least equal to those of the 2 per cent. solution. It is therefore recommended as the best preventive agent at present at our disposal. Sublimate, argyrol, and protargol, too, are trustworthy prophylactics. The efficient prophylaxis of ophthalmia, however, implies more than the mere placing of a drop of silver nitrate or of corrosive sublimate in the baby's eyes at birth. Viewed in its wider sense, it should include the treatment of leucorrhœa and of granular colpitis during pregnancy, and the enforcement of the greatest cleanliness during the entire puerperium.

It is urged that both the prevalence of ophthalmia neonatorum and its severity could be reduced by the adoption of certain other steps, of which perhaps the most important are: (1) the obligatory notification of the disease; (2) the instruction of medical students and of midwives; (3) the education of the public; (4) the appointment of ophthalmic surgeons to maternity hospitals; (5) the keeping and publication of records; and (6) the gratuitous distribution to practitioners of an efficient solution for prophylaxis.

If the British Medical Association and the Ophthalmological Society could now be induced to take up the question of ophthalmia neonatorum, and to move on the lines laid down in this communication—or on better ones, if such there be—we should speedily be brought to within measurable distance of realizing, as far as this country is concerned, Hermann Cohn's famous aphorism, namely, "*Die Blennorrhœa neonatorum kann und muss aus allen civilisirten Staaten verschwinden.*"

APPENDIX.

Tables to show the proportion of cases of *Ophthalmia Neonatorum* presented for treatment at Eye Hospitals. (See p. 11 of the book.)

British Figures.

Observer.	Place.	Period.	No. of Eye cases.	Ophthalmia Neonatorum.	Percentage with Ophthalmia.	Reference.
Reid, T. ...	Glasgow ...	1887-1896	130,532	911	0.69	<i>Private communication to Dr. E. Alvarado, of Valladolid</i> , dated February 27, 1897.
Mules ...	Manchester	1876-1885	112,421	3,517	3.12	<i>Medical Chronicle</i> , January, 1888, <i>Ophthalmia Neonatorum</i> , Manchester, 1888.
Sym ...	Edinburgh	—	6,000	22	0.37	<i>Edin. Med. Journal</i> , May, 1896.
<i>Ibidem</i> ...	Leith ...	—	3,000	21	0.70	<i>Ibidem</i> .
Tyrrell ...	London ...	1899-1901	106,022	233	0.21	<i>Practitioner</i> , April, 1902, p. 438.
Little, D. ...	Manchester	1896	23,364	292	1.25*	<i>Private communication to Dr. Alvarado, of Valladolid</i> , dated December 21, 1897.
Collins, E. T.	London ...	1885	25,863	133	0.51	<i>Practitioner</i> , April, 1902, p. 438.
			407,202	5,129	1.25	

*Dr. Little's figures, however, included "purulent ophthalmia of newly-born children and under 1 year."

American Figures.

Institution.	Period.	Number of Eye cases	Ophthalmia Neonatorum.	Percentage with Ophthalmia	Reference.
Various Eye Clinics of New York City	6 years 1888-1893	37,464	178	0·47	May. — <i>Medical Record</i> , Feb. 16, 1895.
New York Ophthalmic and Aural Institute	12 years 1888-1893	85,975	394	0·45	<i>Ibidem</i>
Manhattan Eye & Ear Hospital	12 years 1888-1893	131,040	735	0·56	<i>Ibidem</i>
New York Eye & Ear Infirmary...	11 years	87,884	546	0·62	<i>Ibidem</i>
New Amsterdam Eye and Ear Hospital	8 years	81,721	480	0·58	<i>Ibidem</i>
Brooklyn Eye & Ear Hospital	25 years	85,364	414	0·48	Jackson. — <i>Trans. American Ophth. Society</i> , 34th Annual Meeting, 1898
Will's Eye Hospital, Philadelphia	—	193,633	683	0·35	<i>Ibidem</i>
Eight Hospitals in Boston, Buffalo, Newark, New York, etc.	—	93,744	441	0·47	<i>Ibidem</i>
Boston	1883	7,468	25	0·33	Alvarado. — <i>Oftalmia purulenta de los recién Nacidos</i> 1904.
New York ...	1893-1896	56,680	292	0·515	<i>Ibidem</i>
Philadelphia ...	1883-1896	77,987	234	0·302	<i>Ibidem</i>
New Orleans ...	1894	2,120	25	1·17	<i>Ibidem</i>
		941,080	4,447	0·47	

Figures from other Countries.

Modified from Cohn's *Verbreitung u. Verhütung der Augeneiterung der Neugeborenen* (1896) and from Alvarado's *Oftalmia purulenta de los Recién Nacidos* (1904).

Country.	No. of Hospitals.	No. of Eye Cases.	Ophthalmia Neonatorum.	Percentage with Ophthalmia Neonatorum.	Remarks.
Germany ...	82	2,221,174	1,297	0.6	
Austria-Hungary	14	59,395	455	0.8	
Switzerland ...	4	10,078	87	0.9	
Holland ...	3	11,324	99	0.9	
Spain ...	28	113,174	1,328	1.176	
Portugal ...	?	19,283	221	1.146	
France ...	23	149,283	1,646	1.10	
Italy ...	18	47,154	553	0.117	
Russia ...	13	258,083	766	0.29	
Belgium ...	4	17,420	215	1.23	
Sweden ...	1	69,121	385	0.557	
Turkey ...	2	30,703	176	0.57	
Mexico ...	1	1,500	23	1.53	
		3,007,692	7,251	0.24	

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